

**Nortel MultiMedia Carrier Switch
Product Guide**



NORTEL
NORTHERN TELECOM

Nortel MultiMedia Carrier Switch

Product Guide

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Contents

Chapter 1 – Introducing the Nortel MultiMedia Carrier Switch	1
A New World of Telecommunications	1
The Corporate Climate	3
Emerging New Operators	3
Global Carriers	4
International Carriers	4
New National Operators	4
Long Distance Service	4
Simple Resale Service	5
Virtual Private Network Service	5
The Nortel MultiMedia Carrier Switch Response	6
Point of Presence – MMCS Access	6
Switching – MMCS Long Distance and Simple Resale Solutions	7
Global Connectivity	8
Service Switching Point – MMCS Intelligent Networking	10
 Chapter 2 – Nortel MultiMedia Carrier Switch System Description	 11
Architecture Overview	11
Connection Management	11
Advanced Call Management	11
Services Platform	12
Performance	13
Reliability	13
Flexibility	13

Evolution	14
Nortel MultiMedia Carrier Switch Hardware	15
The Core Switch	17
Universal Equipment Modules	19
Central Processing Unit	21
Intelligent Peripheral Equipment Module (NT8D37DC)	21
InterGroup Module (NT8D36AA)	22
Circuit Cards	22
Additional Core Switch Equipment	23
Power	25
M-Power	28
Application Platforms	31
Application Platform Configurations	32
Application Platform Hardware	34
Application Platform Specifications	37
MMCS Environmental Information	37
Ceiling Height	37
Loading	38
Approximate Power Consumption	38
Approximate Heat Dissipation	38
MMCS Operating Temperature and Humidity Conditions	38
Other Distances	39
MMCS Management System	40
MMCS Voice Processing Platform	43
VPS Architecture	44
Capacity	45
Additional Equipment	46
Local Area Networks	46
Terminals and Monitoring Devices	46
Chapter 3 – Features and Services	47
Global Networking	49
Network Interfaces Supported	49
Network Access	52
Mastermode – MMCS Point of Presence	53
Overview	53
DASS2 Mastermode	54
DASS2 to ETSI Primary Rate Interface Calls	55

ETSI Primary Rate Interface to DASS2 Calls	55
EuroISDN Mastermode	56
User-to-User Transparency	56
INS1500 Mastermode	57
Italian CAS DTI2 Mastermode	57
Numeris Mastermode	57
Additional Mastermode Protocols	58
Fixed Radio Access	58
Signaling System Number 7	60
MMCS SS7 System Composition	63
Virtual Private Networks	65
Closed User Groups	65
Access Types	67
Routing Mechanisms	67
Overview	67
Basic Routing	68
Intelligent Routing	69
Introduction	69
IR Functional Description	70
Centralized Database Server	75
Intelligent Networking	78
MMCS SSP Configuration	79
Enhanced Services	82
Calling Card	82
Prepaid Debit Card	82
Postpaid Invoice Card	83
Multiple Language Support	83
User Identification	83
International Callback	84
Billing Services	84
Overview	84
Automatic Message Accounting Format	86
CDR Collection	87
Call Rating	87
Customer Invoicing	88
Inter Administration Accounting	88

Flexible Call Detail Recording Application	88
Chapter 4 – Customer Support Services	91
Pre In-service Support	92
Project Management	92
Site Survey	93
Customer Engineering	93
Installation and Unit Commissioning	93
Nodal Integration	94
Network Design and Integration	94
Post In-service Support	95
Warranty	95
Single Point of Contact	96
Customer Service Request Reporting System	96
Customer Technical Services	96
Product Technical Services	97
Engineering and Design Authority	97
Replacement/Repair Service	99
Post-Warranty Support	99
Extended Service Plans	99
First Line Maintenance	99
Additional Value-added Customer Services	100
Technical Training	100
Customer Documentation	100
Acronyms and Abbreviations	101

Chapter 1 – Introducing the Nortel MultiMedia Carrier Switch

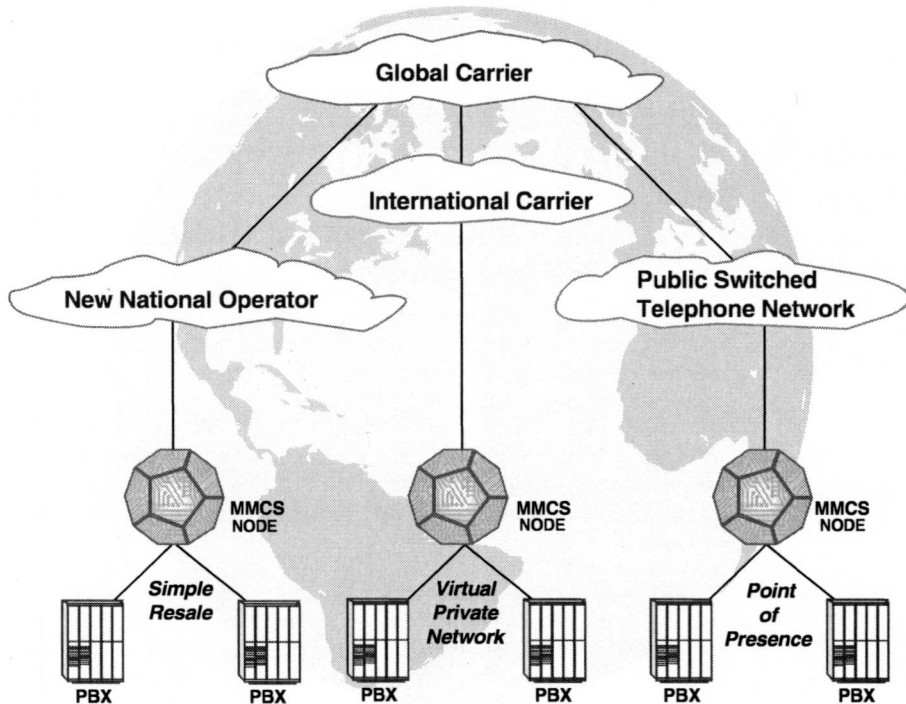
A New World of Telecommunications

Today's telecommunications marketplace is undergoing an exciting transformation as we near the 21st century. The driving momentum of worldwide deregulation is forcing the traditional telephony provider to compete alongside emerging new licensed operators. Boundaries between public and private networks are eroding. Traditional telecommunications solutions and those provided by the computer industry are merging. General purpose computing and switching platforms are now supplying intelligent services and architectures. At the same time, broadband architectures are evolving to support new media such as video and enhanced image transfer.

Business and residential users can now choose between telecommunications providers, whose increasing challenge is to meet users' financial and operational requirements. End users are setting a new standard by changing their traditional office-based profile to one where the organization is flatter, thinner, and more mobile.

The challenge is being taken up by a number of Global Carriers, International Carriers, and New National Operators, all of whom are seeking cost-effective ways to serve the ever-growing group of customers who demand national and international feature-rich networks. Global partnerships are being formed. Many operators are installing overlay networks designed to bypass in-country Post Telephone and Telegraph Administrations (PTTs).

Figure 1
Providing Multiple Carrier Solutions



Several factors are driving the emergence of these alternative carriers:

- deregulation at the local and regional levels
- increasing globalization of trade and communications needs
- the need for transparent delivery of value-added solutions on a network-wide basis, and
- the pressure to reduce operating costs for enterprise networks and competitive service solutions.

The Corporate Climate

Corporations with offices spread across diverse regions, countries and even continents, traditionally look upon private networks as a solution to their growing telecommunications requirements. These leased line networks provide an alternative to public network connections and deliver access to value-added features and services. With economic market globalization and unification, the number of branch offices is growing, and the reach of the corporations is extending to increasingly distant locations. Under these conditions, it is becoming more and more costly to link sites to one another using leased lines or the public telephone network.

In this environment, Virtual Private Networks (VPNs) are the trend for networking large companies. Indeed, up to 90 percent of all Fortune 500 companies now use Virtual Private Networks to meet their telecommunications demands. With deregulation impacting key telecommunications countries, the emerging alternative carriers are offering Virtual Private Network services to address the needs of these customers in terms of cost savings, network-wide value-added services, and worldwide presence.

Emerging New Operators

There are three types of new licensed operators that are emerging: Global Carriers, International Carriers, and New National Operators. Depending upon the target market of the carrier, each carrier requires different functionality streams.

The MultiMedia Carrier Switch (MMCS) has been designed with a flexible architecture to meet the needs of any of these groups. The following are the typical service types that these new operators will be offering:

- Long Distance Service
- Simple Resale Service, and
- Virtual Private Network Service.

Global Carriers

As a result of deregulation and globalization stimulating investment, a number of new alliances and partnerships are being formed. These established carriers demand the global infrastructure and connectivity to extend the range of their businesses quickly and seamlessly to their international customers, as well as a reduction in telecommunications costs. They are also looking to expand their services into more and more countries, all the while maintaining network availability and service reliability. At the same time, they want to provide a full-range of services to their customers.

International Carriers

This is an expanding group of carriers all having the objective of exploiting tariff differentials and earning volume revenues on low-cost international calls and basic services. There are over 200 of these carriers operating out of the United States, some of whom are targeting certain vertical markets. These carriers are looking for a partner who can help them identify opportunities and design networks in countries in which they may have little experience operating.

New National Operators

New National Operators are entering the market that is opening up as a direct result of deregulation. To be successful, they must be able to react rapidly to deploy networks in order to capture critical voice licences offered by governments.

Long Distance Service

The past decade has seen a dramatic increase in long distance service demands from businesses, government bodies, institutions and residential users around the world. Rapid evolution towards a global economy, and the opening of more markets through the reduction of many tariff and non-tariff barriers, has generated even greater demands on telecommunications agencies to provide facilities to support the emerging "Information Highway". At the same time, in many countries the liberalization of the telecommunications industry has resulted in new carriers entering the arena in an attempt to capture this growing long distance business and revenue.

Long distance service providers are setting up separate networks and establishing access privileges to existing public networks. To take advantage of this aggressive market trend, these carriers are demanding switching products that can be deployed cost effectively within a minimal time frame.

Simple Resale Service

This market sector involves a Simple Resale (SR) company leasing bandwidth, typically internationally, and reselling it as an international Public Switched Telephone Network (PSTN) service both for business and residential markets. The Simple Resale company deploys a Point of Presence (POP) to provide connectivity and also to authenticate incoming calls. This POP is then responsible for routing the calls to POPs in other countries. Breakout to the PSTN occurs in each country.

The MMCS supports POP services, including both Simple Resale and long distance, through authentication, either by using Authorization Codes (Authcodes) or Calling Line Identification (CLI) screening. If Authcodes are used, the user must dial a special number that is recognized by the switch before they can gain access to the network. Calling Line Identification authentication is used in countries where public carrier licences are available to Long Distance and Simple Resale companies and CLI is delivered into the carrier's network. In this case, the user does not have to dial any special digits to gain access to the network; access is allowed or denied based on the CLI screening performed by the switch.

Virtual Private Network Service

More and more multinational corporations are demanding end-to-end solutions to their communications needs. These corporations require the creation of international networks that can provide ubiquitous access to a broad range of features and services. The network must accommodate growth, and service evolution, and be able to interface with the networks in many countries. It also must be cost efficient.

An alternative to leased line networks, Virtual Private Networks are gaining increasing acceptance among customers and network carriers by providing corporate networking between geographically dispersed customer premises based on a shared public switch infrastructure. These software-controlled, customized hybrid networks combine elements from both the public network and private facilities, thereby optimizing cost effectiveness.

Virtual Private Network services provided by a carrier include voice and data transmission, and advanced feature transparency between sites located throughout the network depending upon the signaling system being implemented (for example, call display features made available at any site within the VPN).

The Nortel MultiMedia Carrier Switch Response

Point of Presence – MMCS Access

The MultiMedia Carrier Switch can operate as a Point of Presence (POP). As a POP, it acts as the interface between the backbone that is owned and operated by the carrier and other networks including Customer Premises Equipment (CPE), any Private Branch Exchange (PBX) owned and operated by the end user, the country's PSTN, international gateways, and mobile networks.

The MultiMedia Carrier Switch is a Point of Presence acting as an access switch for either Virtual Private Network or long distance services. Points of Presence are installed in each market region to connect users of different networks to one another through the backbone (that is, a client's private network, or the PSTN in various countries). End users are connected to the Point of Presence either directly by a leased line, or indirectly via the PSTN connected to the POP. In turn, the POP is directly connected to the backbone to form a seamless network. The backbone of a carrier's network is comprised of switches able to handle high call volumes (for example, the DMS). Backbone switches are usually linked by an SS7 protocol.

Several advantages result from using the MMCS as a Point of Presence. A shorter leased line is used to bring a new customer in service, which directly results in lower leased line costs. The MMCS enables the existing backbone switches to support more customers. Use of the MMCS allows for cost effective and rapid network deployment; a POP can be deployed closer to the customer in a shorter period of time.

Carriers using the MMCS can customize their network configurations to meet the unique requirements of any particular end user. An important aspect of any Virtual Private Network is the ability to provide a level of privacy that is normally only available through network ownership. Privacy is ensured through the creation of Closed User Groups (CUGs). Closed User Groups involve the maintenance of separate customer profiles in the MMCS. In addition, through the use of Authorization Code features, remote end users must enter a password to gain access to their corporation's Virtual Private Network.

In addition to offering Closed User Groups, the MMCS supports flexible call types, and both Direct and Indirect Access. The carrier's billing system records and formats all information necessary to charge the corresponding end user.

Call destination is determined when a call terminates on an MMCS; other network switches only serve to route the traffic. All digit manipulation and call path determination functions occur at the originating node. This reduces the tromboning off calls paths, and subsequently the number of leased lines required. The MMCS consolidates traffic and reduces the bandwidth used for connecting to the backbone network.

Switching – MMCS Long Distance and Simple Resale Solutions

The MultiMedia Carrier Switch has been specifically designed in response to national and international network operators' requirements for a low-cost switch that will enable them to enter the long distance and resale marketplaces quickly. By deploying the MMCS, emerging new carriers have extraordinary power and flexibility, combined with the ability to expand into many markets. Bandwidth and protocol consolidation provided by the MMCS enable rapid deployment and global service availability.

The MMCS uses industry-standard signaling interfaces and can be implemented as a group of MultiMedia Carrier Switches or as a single-switching element in a larger network topology. Carriers that initially deploy entry-level switches are offered an easy migration path to fully featured Network Service Nodes when market demand justifies cost. The MMCS can be integrated seamlessly into a network consisting of other products in Nortel's public switching and transmission portfolios maintaining service transparency across the network. Advantages arising from such an integration include common network planning support, installation commissioning and integrated network management. Nortel's proven strength in switching fully complements the MMCS as an access switch.

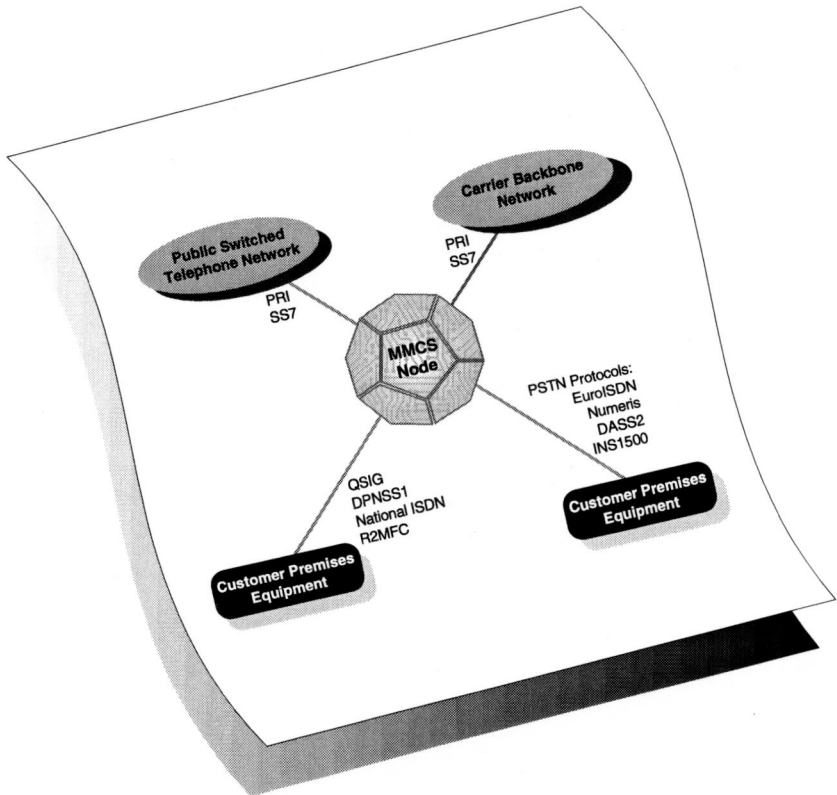
Global Connectivity

Nortel has designed a switching product that is both flexible and responsive to market requirements. The software and hardware architecture is modular allowing network operators to purchase the capacity and capability necessary for their particular network configurations.

The MMCS does not require the large and expensive Central Office space normally expected for a public network switch. To top it off, the design development cycles for the MMCS are much shorter than those of a traditional public network switch. An SS7 variant can be developed in as little as three months from the time a specification has been agreed upon. Replacement of existing in-band signaling technology with SS7 signaling results in immediate trunking efficiencies, higher bandwidth and reduced call set-up times. More importantly, SS7 transport serves as the base for an entire new set of beneficial revenue-generating and cost-reducing services.

As a truly global offering, with user network interfaces supported in over 100 countries, the MMCS is a market-entry platform with clear evolutionary paths to intelligent and broadband networks. The wide range of protocols supported enables carriers to connect more customers to their networks. A-law to μ -law conversion, and T1 to E1 conversion are also provided allowing a single platform to be deployed across the globe. By supporting signaling interfaces in over 100 countries, the MMCS enables the network operator to use a single-switching technology in a worldwide strategy.

Figure 2
Protocols Supported by the MultiMedia Carrier Switch



When using the MMCS, the network operator can offer connectivity to Customer Premises Equipment, as well as local, national, and international exchanges. The MMCS fully supports analog and digital trunks using the following signaling protocols:

- Analog and digital TIE lines
- Integrated Services Digital Network (ISDN)
- Channel Associated Signaling (CAS), or
- Signaling System Number 7 (SS7).

Service Switching Point – MMCS Intelligent Networking

The MMCS can also be used as a Service Switching Point (SSP) in an Intelligent Network (IN). Implementing the MMCS as an SSP in an Intelligent Network enables carriers to define and deploy a wide range of business and residential services with a responsiveness that meets their most challenging customers' demands.

As an SSP, the MMCS offers unique advantages to the customer network. The implementation of an open standard signaling system, using ETSI Intelligent Networking Application Protocol (INAP)/ Transaction Capability Application Part (TCAP), allows the MMCS to originate or terminate queries to any INAP-complaint Service Control Point (SCP) service database. This, in turn, enables the MMCS to operate in, and offer services over, multi-vendor or open systems IN networks.

Intelligent Networking separates the service creation and delivery from the call processing logic, thereby making it quicker and easier for a carrier to configure, deploy and modify services. Using standard, re-usable software modules for service logic reduces development time and costs. Service features already developed and tested can be combined to provide new services. Nortel's MMCS IN offering gives operators greater control over the creation and deployment of their services, and therefore greater control over their businesses.

The MMCS provides the following IN advantages:

- A low-cost SSP solution
- Triggering of SCP-based services, independent of local protocols, to offer centralized:
 - Virtual Private Networking
 - Translation services (Freephone, Local/Premium rate)
 - Advanced billing solutions
 - Indirect Access and sourcing services
 - Personal numbering services
- Easy upgradeability from access (POP) product to an SSP switch, and
- Service platform and management compatibility with Nortel DMS and ServiceBuilder IN products.

Chapter 2 – Nortel MultiMedia Carrier Switch System Description

Architecture Overview

The MMCS has been designed according to the most modern ideas of switch architecture. Nortel distinguishes between call management, connection management and switch services. In many conventional switches these three functions are combined in one software load, leading to problems in the rapid introduction of new switching modes, and new switched services.

In recognition of these problems, current design practice is to layer the switch architecture in the following three ways:

Connection Management

This is the function of establishing connectivity across the switch matrix between input channels and output channels. It is basically a straightforward task which is required to be done quickly, reliably and simply. The MMCS uses the Core Switch to implement this function. As a standalone solution, the MMCS Core Switch can be viewed as the minimum starting configuration for the MMCS. Therefore, basic call management functions such as Call Detail Recording (CDR) generation, are supported on the Core Switch. The basic call model for Plain Ordinary Telephone Service (POTS), as in Simple Resale, is also implemented on the Core Switch.

Advanced Call Management

This is the function of managing progression through the states of the call, and initiating or responding to the diversity of events which can affect call progress. Typically, these more advanced call models are used for offerings such as Intelligent Networking and multimedia calls (for example, the Basic Call Finite State Machine (BCFSM) of the ITU CS-1R Intelligent Networking standard).

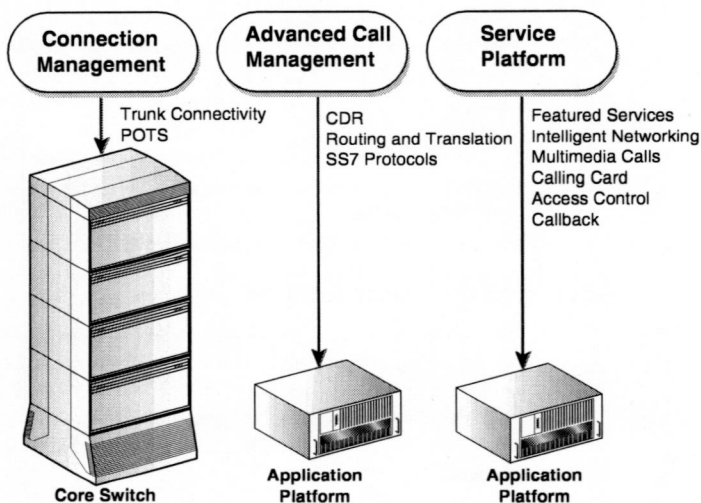
The MMCS implements call models of choice on attached Application Platforms. Services such as Flexible Call Detail Recording format-and-store, enhanced translation and routing, and a diversity of SS7 protocol types are similarly implemented on the MMCS in a modular way using Application Platforms. This modular design provides tremendous flexibility in developing call management and introducing new call models as the market dictates.

Services Platform

This platform, implemented on the Application Platforms, uses a modular approach to support more sophisticated services such as Calling Card, Fixed Radio Access, access control, International Callback, and advanced Intelligent Networking solutions.

The flexibility of the MMCS architecture is a major feature for carriers who are developing new networks in highly competitive markets. It is difficult to plan service rollout, and vital to be able to respond rapidly with new services. The MMCS philosophy is that Nortel should partner with its customers to develop new services in a few months, rather than years. The following illustration depicts the logical interworking of the MMCS architecture.

Figure 3
MMCS Layered Architecture Interworking



Performance

The MultiMedia Carrier Switch offers high performance in terms of port capacities (3000-3600 Digital Signal Level 0 (DS0) trunks depending upon the configuration), and call volumes (typically 18 000- 30000 Busy Hour Call Attempts (BHCA) – trunk-to-trunk with CDR). The high-end Core Switch combined with the off-loading of much of the call processing to the Application Platforms achieves these results. The Application Platform itself is a Pentium-based platform operating under SCO UNIX. In addition, the Oracle database holding the customer's numbering plans reduces access time to a minimum.

Reliability

Critical MultiMedia Carrier Switch components are duplicated so that a failure of one item does not cause the whole MultiMedia Carrier Switch to be blocked. Three Ethernet Local Area Networks (LANs) are used in the MultiMedia Carrier Switch; two replicated LANs handle call-related data, while the third handles other activities such as database updates which is completely separated from the call handling.

The LAN configuration provides a firewall for the live telephony traffic, which only uses a fraction of the LAN's bandwidth and does not share the same LAN as the applications that may require high traffic peaks in emergency recovery situations.

The strategy for overall reliability also involves the use of replicated disks and processors. Intelligent Routing, Flexible Call Detail Recording, SS7, and IN SSP applications have been developed with an integrated redundancy strategy. The Core Switch itself has a fully duplicated Central Processing Unit; self diagnostics, self healing, automatic recovery and alarm routines ensure that down time is kept to an absolute minimum. Finally, the MultiMedia Carrier Switch is directly supported by a highly-skilled team of Nortel technicians.

Flexibility

Flexibility is at the cornerstone of the MultiMedia Carrier Switch design. As a network operator's needs grow, the MultiMedia Carrier Switch will continually evolve to provide exciting new revenue-generating services.

The carrier's investment is protected through Nortel's commitment to ongoing evolution of the MultiMedia Carrier Switch through capacity and feature enhancements. As an SSP in an Intelligent Network, the MMCS offers operators a flexible service creation environment. Operators are able to respond to new demands by providing differentiated services quickly. In particular, in this environment services can be tailored to meet the needs of individual subscribers.

A carrier can rapidly and cost-effectively deploy the MultiMedia Carrier Switch to cover targeted end users by initially installing low-risk Point of Presence switches. These can then be migrated to fully-featured Network Services Nodes when market demands justify cost.

Evolution

The convergence of voice and data services will be a major driver for new public network architectures over the next few years. Operators will have to handle new networked multimedia services, catalyzed by multimedia PCs and web browser technology, as well as the Operations, Administration, Maintenance and Provisioning (OAM&P) simplifications and cost reductions involved in consolidating their voice and data networks. A number of advanced voice services such as MultiMedia Enterprise Networks/VPN will be supported by the MMCS product rollout in 1997. Early in 1998, the MMCS will offer V5.2 for Fixed Radio Access.

In 1998/99, however, there will be a need for the MMCS to support public multimedia services such as Internet-based services (for example, the integration of call center and web-site technology for Internet commerce), and the switching of multimedia calls. In this time period, the MMCS is planned to acquire Asynchronous Transport Mode (ATM) interfaces, and the ability to interface with data protocols such as Frame Relay or Internet Protocol (IP) which are carrying voice. In conjunction with an expanding portfolio of multimedia service applications, the MMCS will provide a clear evolutionary path to future multimedia public networks.

Nortel MultiMedia Carrier Switch Hardware

MultiMedia Carrier Switch hardware components include:

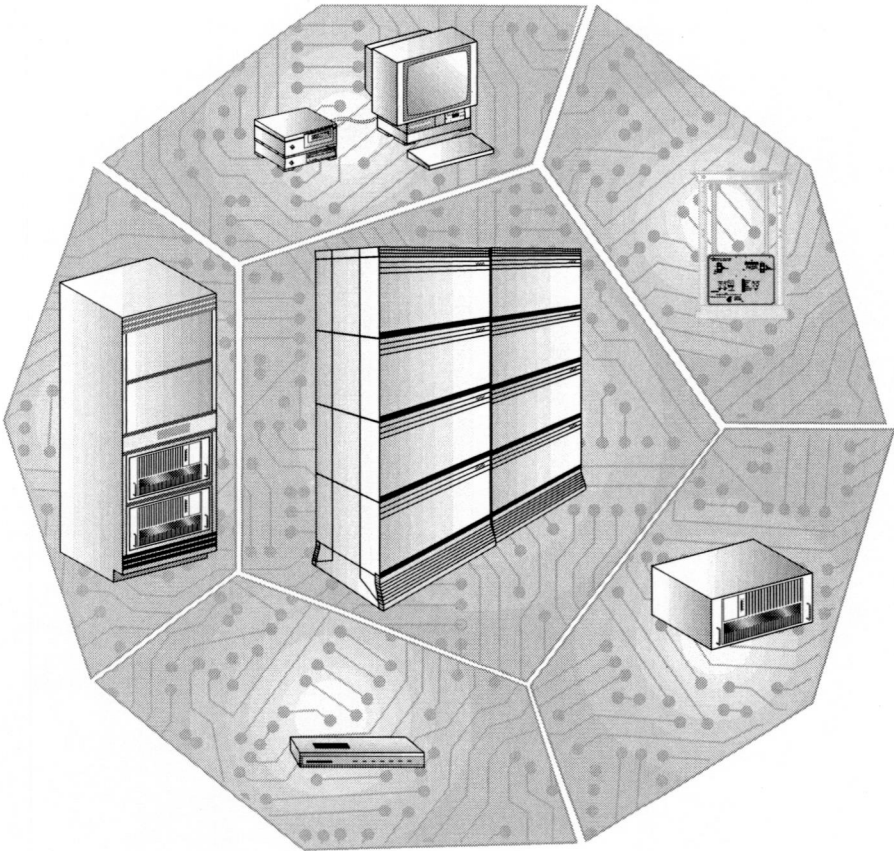
- the Core Switch
 - Calling Card
 - Announcement circuits
- Application Platforms running the following applications:
 - Intelligent Routing (IR)
 - Flexible Call Detail Recording (FCDR)
 - Signaling System Number 7 (SS7)
 - Intelligent Networking (IN) SSP
- a Centralized Database Server
- an MMCS Management System (MMS), and
- various terminals and devices to monitor and integrate the assorted components.

FOR MORE INFORMATION



The sections in this chapter provide a general overview of the MMCS hardware platform. If you require more detailed hardware information, please refer to the *Nortel MMCS Installation Guide*.

Figure 4
MultiMedia Carrier Switch Hardware Components



The Core Switch

The Core Switch is a computer-controlled, digital switching device that uses a DS-30 signaling scheme employed by other Nortel products. In order to provide expanded memory and storage capabilities, and a real-time multi-tasking operating system, the Core Switch is equipped with commercial state-of-the-art processors (redundant Motorola 68040, 32 bit).

Either floppy or hard disk drive mass storage devices are used by the switch as storage mediums. The central processor and disk are fully duplicated, operating in a “hot standby” mode.

The Core Switch requires the following:

- X11 MMCS1 or greater software release
- Trunk cards (for example, Primary Rate Interface [PRI], Digital Private Network Signaling System [DPNSS], 2.0 Mbps Digital Trunk Interface [DTI2], Analog variants) to interface with each element in the network (for example, CPE, PSTN, backbone)
- Multipurpose Serial Data Link (MSDL) cards provide several different types of interface options for the Core Switch (Teletype Terminal port for Operations, Administration and Maintenance [OA&M], Application Module Link) and to serve as D-Channel handlers for Integrated Services Digital Network (ISDN) interfaces. In addition, the fourth port can be configured as CDR to support the FCDR feature on the AP. A minimum of two MSDL cards are required.

The Core Switch can be configured to handle at least 3000-3600 ports depending upon traffic concentration, network configuration and signaling mix. This corresponds to 100-120 T1/E1 cards being supported. Physically more ports can be connected to the MMCS at a lower grade of service.

It consists of a dual Central Processing Unit (CPU), and a maximum of five Network Groups. The following illustration depicts a typical Core Switch.

Figure 5
MMCS Core Switch



Table 1
Core Switch Attributes

Item	Description
Power	DC/AC
Number of Ports – Carrier Grade of Service (CoS)	3000-3600 (T1/E1)
Input Voltage	- 48 V DC
Number of CPUs	2
Number of Network Loops	160
Cooling	Fan Impellers in Pedestal
Memory	48 Mbytes
Storage Media	Redundant; Core Multi Drive Units (CMDUs) each with one 3.5" 4-Mbyte floppy disk drive and a120-Mbyte hard disk.
Software Generic	X11 MMCS1 or greater
Word Size	32 bits
I/O Ports	64
Hardware Features	Up to five Network Groups, standard Power Distribution Unit, System Monitor

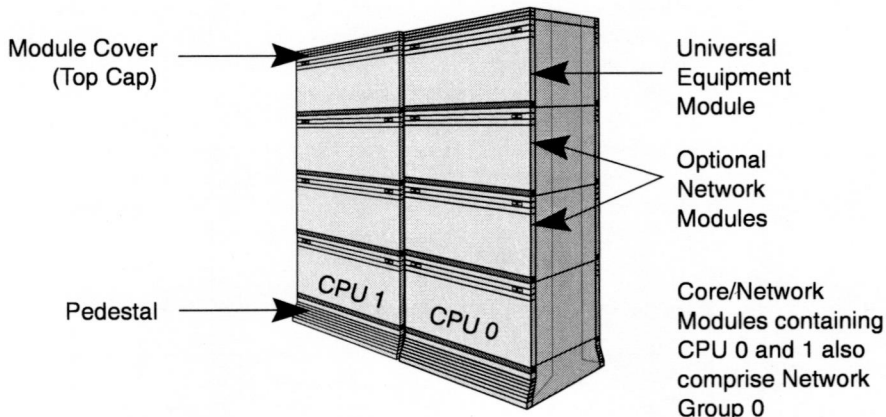
Universal Equipment Modules

The Core Switch comprises Universal Equipment Modules (UEMs) containing various types of card cages, each one supporting a specific function. There are four basic types of Universal Equipment Modules each of which are the same size. Universal Equipment Modules are assembled on a pedestal that provides a central Power Distribution Unit (PDU), cooling units and system monitoring functions. Modules are assembled in columns (up to four Universal Equipment Modules per column) to minimize floor space. The pedestal is equipped with adjustable feet which can be used to level the column. Excluding the InterGroup Switch Module which is non-powered, each Universal Equipment Module is DC powered locally.

Table 2
Core Switch Universal Equipment Modules

Product Code	Description
NT5D21	Core/Network Module house the cards that make up CPU 0 or CPU 1 and Network Group 0 on the Core Switch.
NT8D35DC	Network Module houses the cards that make up one half of a network group (16 network loops). Two modules comprise a network group within the Core Switch.
NT8D36AA	InterGroup Module houses the InterGroup board. One module is required per Core Switch.
NT8D37DC	Intelligent Peripheral Equipment Module houses the cards that make up the Core Switch Intelligent Peripheral Equipment.

Figure 6
Core Switch Universal Equipment Modules



The Core Switch is configured according to the following guidelines:

- Modules may be stacked four high.
- Modules that contain CPUs must be installed on the first or second level above the pedestal to allow for proper cooling.
- The Intelligent Peripheral Equipment Modules can be located away from the Network and CPU Modules up to the maximum network cable length of 13.7 m (45 feet). This means that typically, at floor level, the Network Module serving an IPE Module cannot be more than 6.1 m (20 feet) away.
- A full network group (32 Loops) consists of two half-group Network Modules stacked one on top of the other.
- The InterGroup Module should be at the top of column 0 and adjacent to the NT8D35 Network Modules.
- The floor planning should provide for the future addition of Network groups in one contiguous Common Equipment bay.

- NT5D21 Core/Network Modules must be located next to each other on the same horizontal level.
- All columns must be connected with module expansion kits.

Central Processing Unit

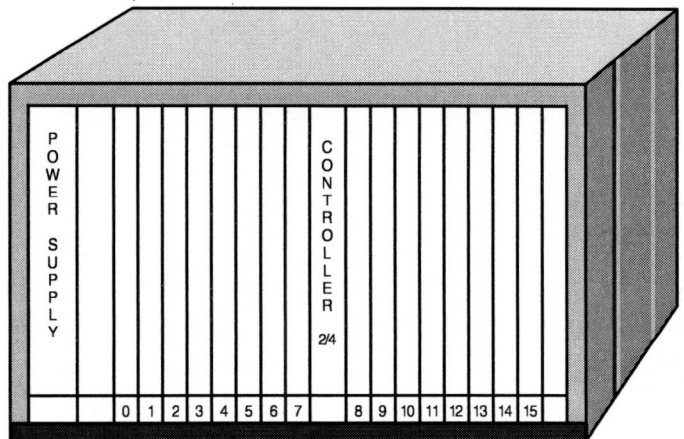
The Central Processing Unit (CPU) provides system control and storage of data and programs for the Core Switch. Central Processing Units contain state-of-the-art processors (Motorola 68040) designed to maximize call processing and routing efficiency. Two CPUs are required for each Core Switch.

Intelligent Peripheral Equipment Module (NT8D37DC)

The Intelligent Peripheral Equipment Modules house Intelligent Peripheral Equipment (IPE) cards. The Intelligent Peripheral Equipment Module has a DC power supply to provide the voltages needed to operate the cards located in this module. Various signaling and other functions are provided by the IPE module depending upon the circuit cards installed in the module.

The Intelligent Peripheral Equipment cards are connected to a Main Distribution Frame (MDF) using 26-pair cables.

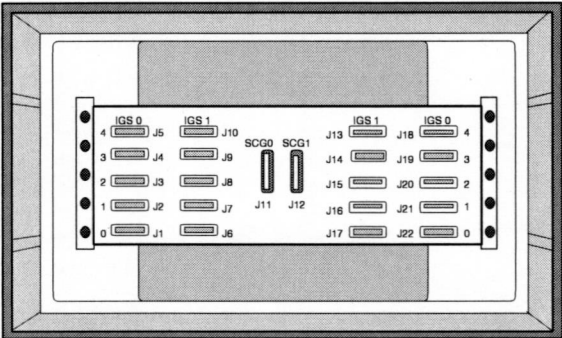
Figure 7
Intelligent Peripheral Equipment Module



InterGroup Module (NT8D36AA)

The InterGroup Module provides a path for the switching traffic between the Network Groups in the Core Switch. Faceplate cables from Segmented Bus Extender (SBE), System Clock (SC), and InterGroup Switch (IGS) cards are connected to the InterGroup Module. The module does not require any power for operation.

Figure 8
InterGroup Module

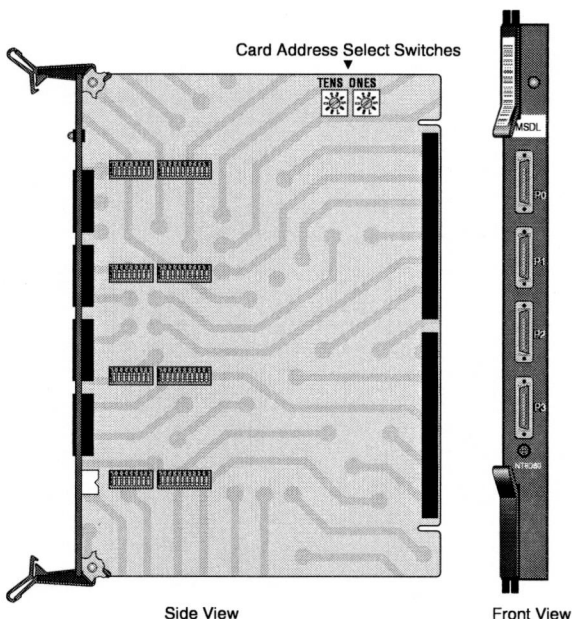


Circuit Cards

System functions in the Core Switch are performed by components mounted on circuit cards. These circuit cards are unique depending upon their function; however, they do share some common characteristics. Circuit cards are 31.8 cm (12.5 inches) by 25.4 cm (10 inches) and can be identified by the part number marked on each faceplate. Some circuit cards have optional switches located on the card itself, and if this is the case, the faceplate is marked with a graphic symbol to indicate their presence.

Other faceplate features can include status LEDS, Enable/Disable switches and cable connectors. All circuit cards include two locking devices, one at the top and one at the bottom, to hold the circuit card in the module. The cards are able to transmit their status, identity, and vintage to the CPU, which enhances both remote maintenance capabilities and inventory control.

Figure 9
Typical Core Switch Circuit Card



Additional Core Switch Equipment

Pedestal (NT7D09CA) – One pedestal is required per column. The pedestal houses the Power Distribution Unit (PDU), blower unit, and fan unit connector. It is approximately 80 cm (31.5 inches) wide by 56.9 cm (22.4 inches) deep by 25.4 cm (10 inches) high and weighs 13.6 kg (30 lbs) empty. Adjustable feet are provided in each corner of the pedestal to ensure that the column is level.

A Power Distribution Unit located in the pedestal contains an Electro-Magnetic Interference (EMI) filter and one 30-amp circuit breaker. Input power for the column is brought into the pedestal and, from there, distributed throughout the system. Also located in the pedestal are two forced impellers and a reusable dust filter. The impellers are protected by two one-amp circuit breakers.

Top Cap (NT7D00BA) – A top cap is mounted on the top of each column. It provides additional Electro-Magnetic Interference (EMI) shielding, air exits, Input/Output (I/O) cable exits and a temperature sensor which regulates the speed of the fans in the pedestal.

The top cap is approximately 80 cm (31.5 inches) wide by 56.8 cm (22 inches) deep by 7.6 cm (three inches) high and weighs 3.6 kg (eight lbs). It consists of front and rear air exhaust grills, each of which is secured by two clips underneath the edge of the grill.

Expansion Kit – The expansion kit, also known as the “spacer kit”, is used to bolt the modules together for side-by-side expansion when in a contiguous row. The expansion kit also maintains EMI/Radio Frequency Interference (RFI) shielding.

Teletype Terminal – The Teletype Terminal (TTY) is a VT520 data terminal used to transmit and receive commands and responses when an administrator is programming the Core Switch. Generally, a TTY refers to any dumb terminal that can be used to pass ASCII data. As a system management interface, a TTY is used to configure and administer the software residing on the Core Switch. Software is configured by accessing various Operations, Administration and Maintenance (OA&M) programs. In addition, a printer can be connected to the TTY for printing OA&M information (that is, the prompts and corresponding responses that have been entered).

Cabling – Core Switch cables are differentiated depending upon the cabling method used. Two types of cables are available: Intra-Module; and Inter-Module.

Intra-Module cables either connect to different cards within a module or lead to the I/O connector panels at the rear of a module. Intra-Module cables are not shielded. Typically, these cables are round and are fastened with bail locks or screws to prevent accidental removal.

Inter-Module cables are routed internally between modules. These cables are primarily used to interconnect the following subsystems: CPU to CPU; CPU to Network; Network to Network; and Network to Peripheral Equipment.

Power

The Core Switch utilizes a power distribution architecture that follows the modular design concept of the Universal Equipment Module packaging. The basic Core Switch power system provides the following features:

- Distributed, modular power architecture, with power supplies located in each module, rather than in separate, centralized power shelves.
- Modules are truly universal in terms of power and cooling.
- The Core Switch is designed so that there are no restrictions as a result of power or thermal limitations: any card can go in any slot, and all modules can be filled to capacity with any (logically) valid combination of cards, with no engineering rules.
- A System Monitor has been designed to provide enhanced power, cooling, and general system monitoring capabilities. The System Monitor interfaces to the CPU via a Serial Data Interface paddleboard card for intelligent error and status reporting.
- Maintenance messages indicate the location of power faults and status down to the specific column and module.
- An advanced cooling system employs forced air impellers (Fan Blower Unit). The velocity of the impellers is automatically adjusted to meet the cooling requirements of the system.
- Fuses are eliminated as the system exclusively uses circuit breakers for safety.
- Highly proven overall reliability throughout the power and cooling system.

The Core Switch features a modular power distribution architecture. As part of the modular design, the Core Switch power system provides:

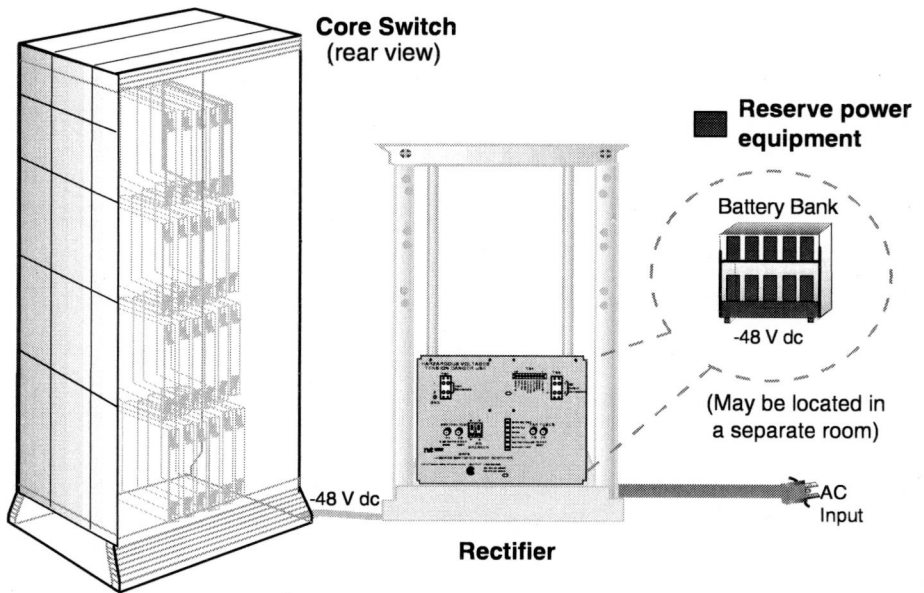
- A power distribution unit located in the pedestal which functions as a distribution point for the input voltage (AC or DC) to each of the modules and protects them from current overload.
- Power supplies located in each module, rather than in separate centralized power shelves.
- A universal quick-connect power wiring harness, which carries the power and monitor signals to the power supplies in each module.
- Modular backup capabilities on a per-column basis.

To understand the Core Switch power architecture, consider the distinction between the “internal” and “external” power components. Internal power components are those contained within the Core Switch itself that form an integral part of the Core Switch power subsystem. These include components such as the Power Distribution Unit (PDU) in the pedestal, the power wiring harness, and the module power supplies.

Although the PDU and module power supplies differ in AC- and DC-powered systems, power distribution is similar: power is input to the pedestal and distributed to individual power supplies in each module. In AC-powered systems, the module power supplies convert the AC voltage to several usable DC voltages; in DC-powered systems, the module power supplies convert the DC voltage to several usable DC voltages.

External power components are those outside the Core Switch columns. If reserve power is not required, AC-powered systems have no external components; AC systems plug directly into the commercial AC power source. If an uninterruptible power supply (UPS) is installed for reserve power, it is considered an external power component. All DC systems are powered by rectifiers that are external to the system.

Figure 10
Core Switch DC Power System

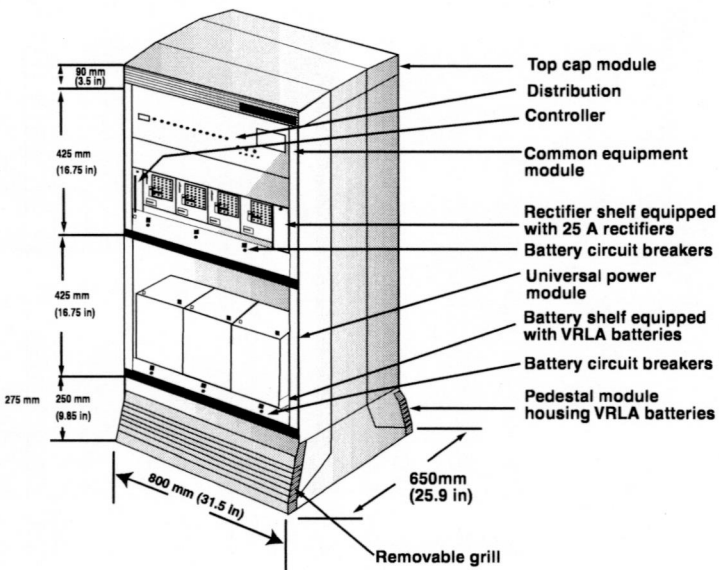


The power cables enter the pedestal and connect to an internal terminal block located beneath the PDU. From there, the DC voltage enters the PDU, which has five circuit breakers – one for each of the modules and one for the blower unit. The System Monitor runs off a small AC-DC converter in the PDU. The module-to-module power harnesses distribute DC power to each module directly to the DC power converters, which contain on/off switches for easy maintenance. Circuit breaker protection is provided in the pedestal.

M-Power

An optional power offering, M-Power with both AC and DC versions, can be used to provide power to the entire MMCS system. M-Power has been specifically developed and designed for Nortel's MMCS family of products. Part of the philosophy in developing the M-Power range was not just to satisfy existing requirements, but also to meet future requirements as the core product and regulatory requirements evolve over the next few years. This section describes the M-Power MMCS Core Switch DC Power System.

Figure 11
Typical configuration for a 100A M-Power system



System Performance – M-Power out ranks any other power system within its class due to its complete MMCS core product orientation. Independent power systems manufacturers find it necessary to target as wide a marketplace as possible, often leading to dilution of functionality and quality of their product when related to supporting one specific core platform.

One of the many benefits of M-Power is that Nortel focussed on the specific requirements of MMCS, rather than an “independent” power system. This focus has led to the development of an integrated Power System which is focused on guaranteeing the integrity of the core MMCS Platform, including specific areas such as earthing, ohmic impedance, alarms, installation, maintenance, life cycle costs and even the aesthetics of the system to exactly match the Core Switch.

Rectifiers – M-Power can provide more power per cubic meter than conventional independent power systems. A one column configuration can provide up to 200 amps in modular hot plug-in 25 amp blocks. The M-Power system achieves its space saving superiority by the use of the MPR25 PFC rectifier which is approximately half the size of similar OEM devices and incorporates power factor correction circuitry which complies to the new EC requirements. The MPR25 amp rectifier has an actual measured MTBF of 1,200,000 hours. There are over 80,000 MPR25 amp rectifiers in operation around the world, providing the reliable DC power platform so vitally required within the network operator, financial, transport and military environments.

Batteries – In order to choose the correct battery for the M-Power system, Nortel reviewed the key factors required for the MMCS platform: reliability, density, size, weight, cost effectiveness and quality.

Following extensive research and testing, the Hawker SBS60 was chosen. The SBS60 battery provides greater density for its size and structure than any other model currently available; coupled with its track record for reliability and quality this makes it the ideal choice for the M-Power system. Although the SBS60 battery has a quoted life of 15 years, independent tests have actually shown a life expectancy of 17.5 years. This is a major advantage over the average battery and allows the same battery to be used throughout the life of the product, rather than having to implement a costly battery changeout program every two to three years.

The quoted life expectancy of batteries is based on maintaining the batteries at a recommended temperature and condition over the life of the battery; therefore, although the quoted life may appear more than adequate upon first examination, for every few degrees outside the specification this can dramatically reduce the life of the battery. In today's fast moving world of networks, it is not always possible to maintain the batteries at the ideal temperature, either due to the accommodation or costs involved in controlling the environmental situation.

In this case, batteries with a quoted life expectancy of five to seven years may in fact only provide two to three years service. The SBS60 has a measured expectancy of 17.5 years, so even under conditions that are not ideal, the battery life can still match the product life cycle, hence dramatically reducing the potential life cycle costs and guaranteeing the integrity of the MMCS' revenue-generating ability.

The M-Power system has the capacity of supplying up to 315 AH per column. A 100 amp system with four hours battery backup can be accommodated within one M-Power column. 70 percent of all MMCS power configurations will be accommodated by a one-column, two-module high M-Power system. If a greater battery backup is required this can be achieved by adding a further column to the line-up.

Installation improvements – Many conventional based power systems require both rear and top access for system cabling. This necessitates in many cases the removal of the back panel and top grills to gain access, and subsequent replacement of heavy sheet metal back panels and large quantities of screws used to secure these sections. As a result of this rear access requirement, these units cannot be placed against the wall and a certain level of additional space around the unit has to be allocated to allow for installation and maintenance work. Due to M-Power's front/top access there is far more flexibility available in locating the system, either against a wall or in the MMCS line-up.

The M-Power system is front/top access and requires the removal of plastic top cap and grill (a total of six screws).

As M-Power is designed to allow placement in the same line-up as the MMCS system, this results in:

- Reduced cable runs from M-Power to MMCS, and
- Reduction in overhead racking runs since M-Power can utilize in-row MMCS overhead racking.

Maintenance – M-Power is extremely maintenance friendly allowing the end user to maintain the system without causing any risk to the functionality of M-Power or the MMCS. A combination of the N+1 configurability and the MPR25 amp rectifier's hot plug facility, which allows the unit to be swapped during live operation, guarantee M-Power's operational stability and drastically reduces the potential cost of ownership.

Application Platforms

The MultiMedia Carrier Switch Application Platforms (APs) provide server-based customized applications. The flexible architecture of the MultiMedia Carrier Switch enables the exchange of commands and messages between the Core Switch and the computer-based Application Platforms to monitor and control the Core Switch, and provide sophisticated applications such as Intelligent Routing, Flexible Call Detail Recording, SS7, and IN SSP. The use of Application Platforms provides revenue increases, and enhanced customer service and productivity for the carrier.

The Intelligent Routing application residing on the Application Platforms offers both the access control methods (for example, Direct Access, or Indirect Access validation) and the routing services (for example, long distance, VPN).

The Flexible CDR application residing on the Application Platform receives Call Detail Record tickets from the Core Switch and IR and IN applications. It then merges and stores the records. Both the Flexible CDR application and the Intelligent Routing application reside on the same Application Platform, with a second Application Platform provided for redundancy.

The SS7 physical interface, as well as the protocol stacks, are provided by the Application Platform (AP) in association with the Core Switch. SS7 protocol capabilities are implemented on the MultiMedia Carrier Switch through an application running on the Application Platform.

The main function of the SS7 application is to operate as an integrated protocol engine. It converts Integrated Services Digital Network (ISDN) 7sig signaling (from/to the Core Switch) to SS7 signaling (from/to the SS7 network). In addition, the SS7 application offers automatic maintenance, channel negotiation and trunk recovery capabilities to ensure optimum network performance. The SS7 application requires its own Application Platform, with a second Application Platform provided for redundancy.

The IN SSP application residing on the Application Platform provides the basis for enabling the MMCS to function as an SSP in an Intelligent Network. As an SSP, the MMCS will be equipped with signaling capabilities that enables it to originate or terminate CCITT7 messages and queries to network Service Control Points.

Table 3
Application Platform Attributes

Item	Description
Platform	Pentium-based operating under SCO Openserver 5 (UNIX system V release 3.2 version 5.0)
Memory	64 Mbytes RAM; 1 Gbyte hard disk
Applications	Intelligent Routing Application and database (Oracle version 7.0) Flexible Call Detail Recording SS7 IN SSP
Hardware Version	Rackmount
LAN Connectivity	Two Ethernet cards support telephony traffic and redundancy operations.

Application Platform Configurations

Application Platforms need to be connected to the Core Switch. Ethernet LANs 1 and 2 connect the Core Switch to the IR application running on the APs. These LANs only handle IR functions as dictated by the MMCS IN Foundation (MIF) feature (both Core Switch and IR routed calls). LAN 3 supports background traffic and facilitates system redundancy.

The term APBase is used to describe everything which is basic to the Application Platform environment including the SCO UNIX system V customized to the needs of the MMCS, as well as the programs used as tools and services.

The following section describes the basic needs of APBase and the applications that run on it.



FOR MORE INFORMATION

For more information on how to configure Application Platforms, please see the *Nortel MMCS Application Platform User Guide*.

Table 4
Definition of Application Combinations and Sizes

Product	Approximate Product Size (including executables + trace)	Data Size	(A) CDBS	(B) IR FCDR	(C) ISUP/TUP	(D) FCDR Storage	(E) IN FCDR	(F) IR FCDR ISUP/TUP	(G) IN FCDR ISUP/TUP	(H) ISUP/TUP FCDR Storage	(I) IR
APBase	2 MB	0 MB	√	√	√	√	√	√	√	√	√
Oracle	250 MB	0 MB	√	√				√			√
IR	111 MB (15+6*16 MB)	2 GB		√				√			√
FCDR	20 MB (2.2+16*1 MB)	2 GB		√		√	√	√	√	√	
MTP	2 MB	0 MB			√		√	√	√	√	
ISUP/TUP	2 MB	0 MB			√			√	√	√	
TCAP/SCCP	17.3 MB (1.3+16 MB)	0 MB					√		√		
CDBS	80 MB	2 GB	√								
IN	97 MB (1+6*16 MB)	0 MB					√		√		
VPS	161 MB (0.6+10*16 MB) (see note)	0 MB		√				√			√
PWS	15 MB	0 MB	√	√				√			√
Note: 256 VPS cards are potentially plugged into the Core Switch; in practice, only 10 could be plugged, each of them requiring a trace file.											

Application Platform Hardware

Application Platforms are used to provide an execution environment to the applications and also to provide LAN/WAN capabilities. The platform chosen is from the Digital Equipment Corporation (DEC) Prioris range. Up to three Application Platforms are mounted in a common rack; they share an SVGA monitor, keyboard and mouse through a switching system. Each AP supports a 9600 bps modem on COM1 (COM2 is reserved for the CDR application). All shelves are on sliding rails that can be easily pulled open for maintenance or upgrade procedures. Sliding shelves are used to house the APs, whereas fixed shelves accommodate other system equipment (for example, modems, the Terminal Server, hubs, and the Master Console Switch).

Figure 12
MultiMedia Carrier Switch Application Platform

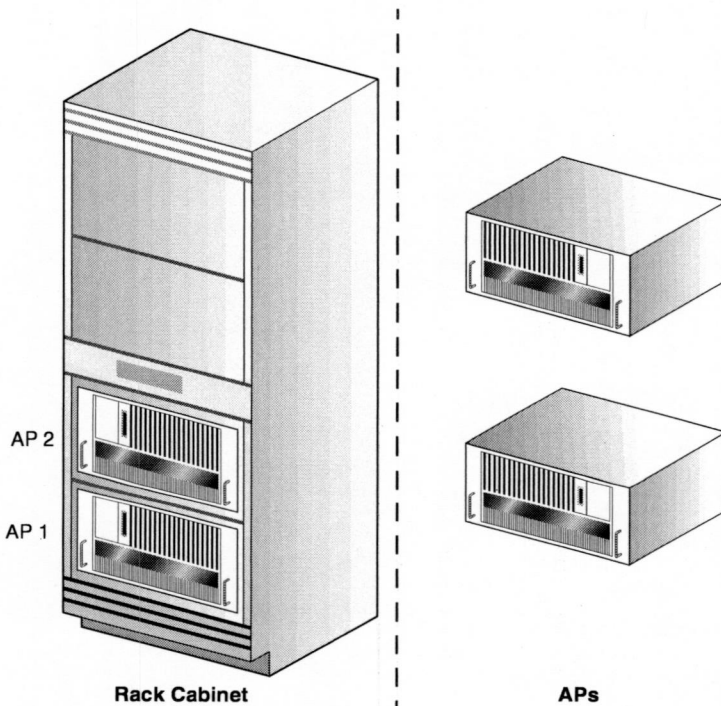


Table 5
Hardware Definitions for Different AP Configurations

Hardware	(A) CDBS	(B) IR FCDR	(C) ISUP/TUP	(D) FCDR Storage	(E) IN FCDR	(F) IR FCDR ISUP/TUP	(G) IN FCDR ISUP/TUP	(H) ISUP/TUP FCDR Storage	(I) IR
Rack Mount Prioris HX 5133 single processor 133 MHz Pentium with 512KB cache 6 EISA, 6 PCI, 7 wide SCSI-2 I/O slots 420 W max. power supply location for a redundant power supply	1	1	1	1	1	1	1	1	1
32 MB ECC SIMM	2	2	1	1	2	2	2	1	2
YE Data 1.44 MB floppy disk drive, EISA	1	1	1	1	1	1	1	1	1
Adaptec card 2940W, 1 channel, PCI fast wide SCSI-2 Toshiba XM5401B CD-ROM drive	1	1	1	1	1	1	1	1	1
Mylex Raid-5 card, 1 channel, PCI fast wide SCSI-2	1	0	0	0	0	0	0	0	0
Seagate 2 GB wide SCSI-2 hard drive, 20ms max access time	4	3	1	2	2	3	2	2	2
DEC Network card DE450, PCI, Ethernet, 1 channel, 10base2, 10baseT, 10base5 connections	1	2	2	2	2	2	2	2	2
Tandberg TDC4220 2.5 GB tape drive, SCSI	1	2	1	1	1	2	1	1	1
Telesoft RS 422 card	0	0	2-6	0	0	2-6	2-6	2-6	2-6

Table 6
Application Platform Technical Specifications

Equipment	Description
Processor	5133 Pentium 133 MHz, expandable to dual processor.
Memory	System: expandable from 16 MB to 512 MB parity, or 32 MB to 256 MB ECC. Cache: 512 KB secondary cache standard.
Integrated Controllers	Video with Cirrus Logic 5428 VGA with 512 KB video memory supports 1024 x 768 x 16 colors and 800 x 600 x 256 colors.
I/O Slots	12 total (all bus master) – six PCI and six EISA.
Bays	There are seven 3.5" front-accessible bays for hard drives. One 3.5" front-accessible 1.44 MB diskette drive installed. One 5.25" front-accessible CD-ROM bay installed. Two 5.25" front-accessible half-height bays.
SCSI Support	One and two channel PCI Fast Wide SCSI II. One and two channel PCI Fast and Wide RAID (Supports 0, 1 and 5).
Operating System	SCO Opensystem 5.0.
Security Features	CMOS password; diskette lockout; keyboard lockout; two keylocks on chassis.
Ease-of-Use Features	CD-ROM on-line technical reference. Operator Control Panel.
Power	450-W autoranging 110V/220V (5V/3.5V output). Optional redundant 450W power supply.
Cooling	Five variable speed fans (two redundant).
External Ports	Two external SCSI port knockouts; 50 pin narrow, 68 pin wide. One parallel (ECP/EPP). One mouse. One keyboard. Two high-speed 16550-compatible serial. One graphics.
Dimensions	53.3 cm (20.16") high x 162 cm (64") wide x 59.1 cm (23.31") deep.
Weight	27 kg (60 lbs) – without hard drives.

Application Platform Specifications

The number of rackmount Application Platforms depends on the size and feature capabilities of the actual system. However, it is expected that one rackmount cabinet will be able to contain the maximum number of Application Platforms required for the 600 and 1200 port configurations; two cabinets are required for the 1800 port configuration.

Table 7
Equipment Dimensions for the Application Platform Rackmount Cabinet

Equipment	Width		Depth		Height		Weight	
	cm	in.	cm	in.	cm	in.	kg	lb.
Rackmount Cabinet	60.0	23.6	308.6	121.5	212.5	83.7	180.0	396.0
Note: The dimensions in this chart include the necessary space allocated for accessibility around the rackmount cabinet.								

MMCS Environmental Information

Ceiling Height

The minimum ceiling height for MMCS equipment is normally 2.4 m (8 ft.). However, it is possible to accommodate equipment within the ceiling height of 2.2 m (7 ft. 1.5 in.) as follows:

- MMCS Core Switch equipment can be installed in columns three modules high instead of the normal four. This will increase the number of columns to five.
- MMCS APs are normally provided in a rack cabinet which cannot be reduced in height. The rack provides a mechanical housing for the APs and LAN infrastructure equipment and power distribution cabling for them. However, all equipment in the rack is cabinetized, so is capable of being installed free standing. Additional floor space would be required for the APs and additional desktop space for the LAN hubs, Terminal Server and SVGA monitor.
- M-Power equipment is a maximum of three columns high; therefore, this equipment can be installed without modification.

Loading

Core Switch floor loading = 3.9 kPa (83 lbs/sq ft.) (three modules high)
Core Switch point loading = 164 kPa (24 lbs/sq in.) (three modules high)

M-Power floor loading = 13.4 kPa
M-Power point loading = 115.4 kPa

M-Power DC weight = 724 kg (1596 lbs)
M-Power AC weight = 650 kg (1433 lbs)

1 kPa = 1 kN/sq m

Approximate Power Consumption

MMCS Core Switch = 70 amps @ 48v DC (provided by M-Power DC)
MMCS APs = 2 KVA @ 230v AC (provided by M-Power AC)
M-Power DC input = 2 feeds of 30 amps @ 230v AC, single phase
M-Power AC input = 1 feed of 15 amps @ 230v AC, single phase

Approximate Heat Dissipation

Core Switch 10,000 BTUs/hr
APs 10,000 BTUs/hr
M-Power 10,000 BTUs/hr

Total 30,000 BTUs/hr

MMCS Operating Temperature and Humidity Conditions

<i>Recommended</i>	<i>Absolute</i>
15-30° C (59-86° F)	10-45° C (50-113° F)
RH 20 to 55%	RH 20 to 80%
Non-condensing	Non-condensing
	Temperature change less than 10° C (18° F) per hour

Note: Temperature changes should be taken 760 mm (30 inches) from the front of the system.

Frequent and extended operation above the recommended temperature limits may degrade system reliability. M-Power is able to withstand more extreme conditions.

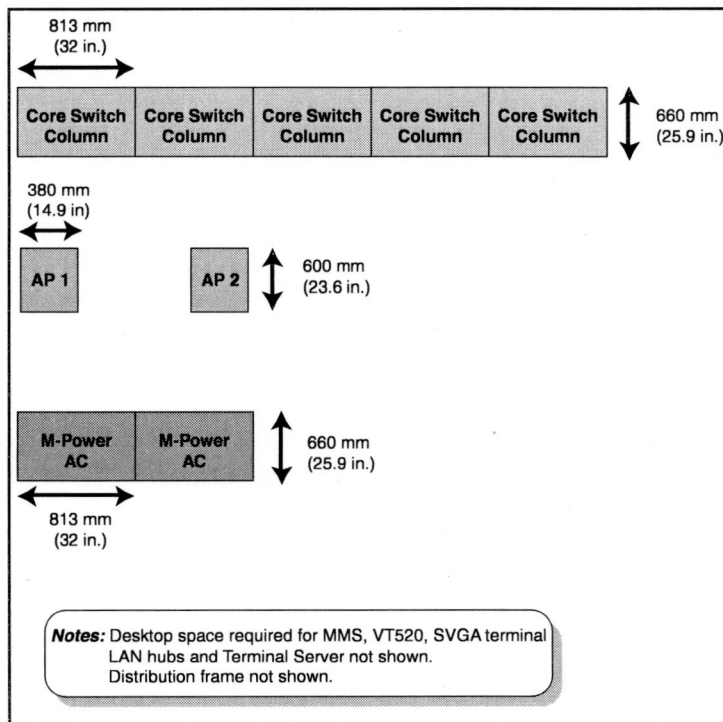
Other Distances

Minimum distance from walls = 91 cm (36 inches)

Minimum distance between equipment aisles = 76 cm (30 inches)

Maximum distance between Core Switch and APs = 10 m (32.8 feet)

Figure 13
Sample MMCS Floorplan Showing Width and Depth of Columns



Note: It may be necessary to have a sixth column in the Core Switch or increase the power required.

The Power and Distribution frame are not included as these items are normally provided by the carrier. The M-Power equipment will become available later on in 1997; the M-Power equipment described in this section is based on a four-hour battery backup.

Under floor cabling is assumed; overhead cabling can also be used.

MMCS Management System

The MultiMedia Carrier Switch Management System (MMS) enables all components of the MMCS to be managed from a single system management station. The MMS is a menu-driven system that manages alarm messages received from the Core Switch and Application Platforms. In addition to alarm surveillance, the MMS provides access to the MMCS components through the use of a Graphical User Interface.

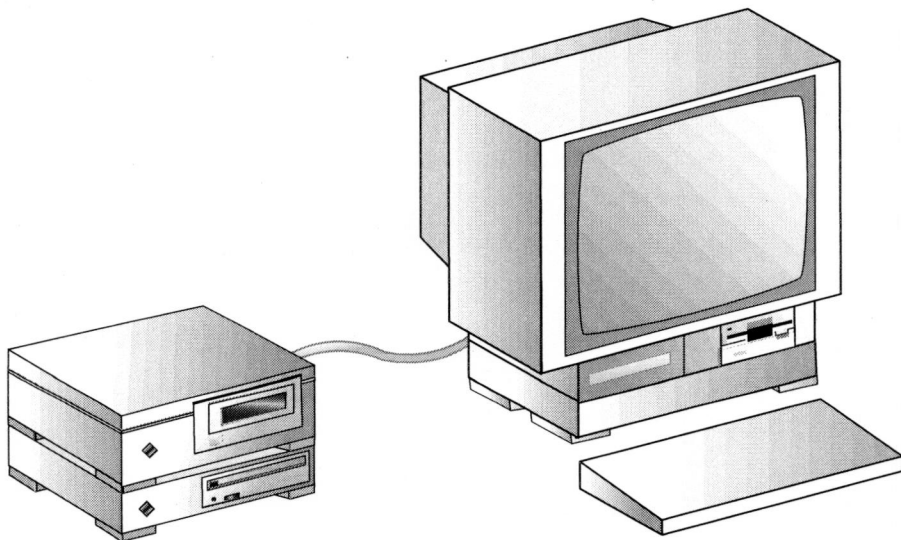
The MultiMedia Carrier Switch Management System consists of:

- an MMCS alarm mediation server
- Advisor tools to log and track alarms
- an MMS custom toolset
- a utility to enable users to directly communicate with any MMCS device for configuration management
- a Core Switch Alarm Indications document that lists and describes Core Switch alarms
- access to all MMCS Customer Documentation on CD-ROM
- on-line help, and
- an MMS Installation and User Guide.

The following table describes the attributes of the MMCS Management System.

Table 8
MMS Attributes

Item	Description
Packages	Advisor and Architect.
Connectivity	Direct connection to the MSDL card serial ports on the Core Switch via RS-232 serial links. Two serial port connections are required: one for alarm management, and the other for configuration management. The MMS is connected to the applications running on the Application Platforms via Ethernet (that is, 10BaseT). Data exchanges are handled over UDP/AP. Applications on the AP send alarms to a central Error Logging Module (ELM residing on each AP) which forwards the alarms to the MMS over UDP/IP.
Cards	The Aurora card provides Ethernet support.
Toolsets	Server Control Utility; Alarm Filter Tool (for the Core Switch only); Configuration Access Tool.

Figure 14
MMCS Management System (SPARCstation 5)

The MMCS offers carriers a scalable management solution. A carrier can start with an element manager for each site and then migrate to a complete multi-element screen integration management system. This management strategy protects a carrier's initial investment, but also enables a single MMS to be used to manage multiple MMCS nodes. During the growth of a network, multiple sites can all be viewed and managed from a central location through the use of multi-element screens on the MMS, one allocated for each node in the network.

There are several system management functionalities available with the MMCS. Configuration Access Management includes: Core Switch configuration via a pass-through capability; and access to the Application Platform OA&M (IR, CDR, SS7, IN SSP applications) via a pass-through capability.

Fault management focuses on Core Switch alarm handling, and IR, CDR, SS7, and IN SSP alarm handling. Records of alarms can be printed at regular intervals to help facilitate troubleshooting activities often without service interruptions.

Accounting management is not performed by the MMS, but instead is handled directly by the Flexible CDR application. Traffic monitoring capabilities can also be provided on the MMS by using Meridian Administration Tools (MAT) technology. By carefully analyzing network traffic, a carrier can react quickly to service growth requirements and thus have plans in place to reconfigure or grow their network before a blockage situation has a chance to occur.

Nortel provides an even more comprehensive network management solution through the use of its NETWORKS management system. NETWORKS not only enables each MMCS node to be maintained and administered remotely, but also is designed to provide the same functionality for other components in the network (for example, Magellan and DMS products). NETWORKS provides an integrated fault and performance management tool for switched, transport and wireless networks in a multi-vendor environment.

Key advantages of comprehensive network management include the reduction of operational costs, real-time monitoring of traffic, and comprehensive control capabilities. Optimization of network resources directly corresponds to a reduction in call blocking and increased revenue opportunities for the carrier.

By early 1998, Simple Network Management Protocol (SNMP) will be supported. In addition, possible Management Information Base (MIB) exchange through Application Programmable Interface (API) to other network management systems such as Nortel's NMS or HP OpenView, in order to enable fault and alarm management in so called umbrella network management systems like NETWORKS, will be introduced.



FOR MORE INFORMATION

If you require more detailed information about the MMS, please see the *Nortel MMCS Element Management User Guide*.

MMCS Voice Processing Platform

Voice Processing capabilities are required by the MMCS in order to support a number of Intelligent Routing, Intelligent Networking and other services. These services include remote access capabilities to a customer's Virtual Private Network (VPN), including Authorization Code and Calling Card validation, and other value-added features such as International Callback.

The comprehensive MMCS Voice Processing (VP) offering provides a cost-effective Interactive Voice Response (IVR) functionality consisting of: a VP card and hardware platform, a VP server used to store client-specific application data, and a Voice Processing Application User Interface (VPAPI). Running on the VP hardware platform is the MMCS Voice Processing application that enables the VP system to decompress and play voice prompts, and generate and collect Dual-tone Multifrequency (DTMF) digits using up to 24 Digital Signal Processing (DSP) ports. The system is used for playing prompts to a caller, as well as collecting the necessary digits to either authorize or disallow the call to proceed.

The following are some of the attributes of the MMCS VPS:

- scalable, industry standard architecture
- rich set of both standard and proprietary interfaces, and
- easily expandable.

In the future, the MMCS VP system will provide the foundation for additional applications such as speech recognition and expanded prompt storage capabilities.

VPS Architecture

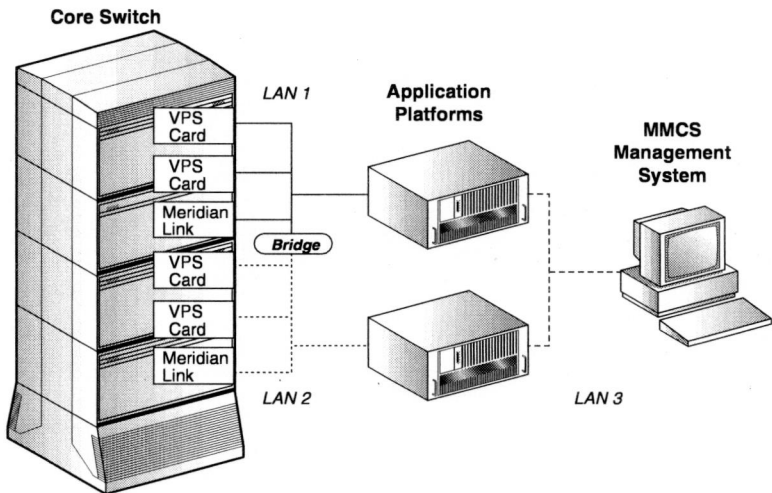
The VP Core Switch card is a single slot, IPE-based embedded computing platform that provides a cost-effective, multi-tasking environment for voice processing applications. The MMCS VP interfaces with the Core Switch through an M2616 set emulation functionality, and to the Application Platforms through a TCP/IP connection over a 10BaseT Ethernet link. A fully equipped MMCS VP system requires, in addition to the VP card: two DSP cards, one PCMCIA flash card, and an Ethernet device. It supports up to 24 DSP ports and 24 M2616 sets (provided that the Flexible Voice and Data TN feature is equipped).

A VP system is not directly connected to the MMCS Management System (MMS), but instead is connected through the APs acting as routers. To the APs, the VP system appears as servers that provide certain functionalities over a voice channel (that is, play a prompt or sequence of prompts and/or DTMF tones on the channel and/or collect DTMF tones from the channel). Connectivity between the APs and the VP cards is over a TCP/IP connection using Ethernet as the link layer.

All voice prompts must be recorded on an external system and downloaded as sub band coded (.sbc) files using FTP. A Multimedia Prompt Workstation is used for the creation and editing of voice prompts in .wav format. A PC utility is then used for conversion between .wav and .sbc formats.

Voice prompts are stored as files in a DOS-compatible hierarchical system imposed on the PCMCIA Type II flash card. These files are distributed and stored in .sbc format at a compression ratio of more than 3.5:1 over eight bit companded Pulse Code Modulation (PCM). To play a voice file, the DSP first decompresses the file to companded PCM, and then inserts the PCM into the specified DS30 timeslot to the backplane of the Core Switch. The following illustration shows a typical MMCS VPS configuration.

Figure 15
VPS in the MMCS LAN Environment



Capacity

The MMCS VPS is able to maintain 24 simultaneous calls indefinitely. Each card can process three calls per port per minute, or 4320 calls per card per hour. The overall storage capacity in the initial MMCS VPS offering is five hours which translates into 75 prompts in eight languages at 30 seconds each.

Additional Equipment

Local Area Networks

Three Ethernet LANs coexist within the MMCS. The first two LANs, which duplicate each other for redundancy, handle telephony traffic such as route request and route call responses from the Core Switch to the Application Platforms, and route call requests from the Application Platforms to the Core Switch. The third LAN carries the traffic between the two databases used for Intelligent Routing application provisioning, or in the case of crash recovery. The third LAN is also used for connecting the MMS to the MMCS system.

The clear separation of LANs ensures that the telephony traffic will not be impacted by any data transfer being handled by the third LAN. The three LANs are Ethernet (10BaseT) and are represented by three 12-port hubs (Cabletron SEH-22).

Terminals and Monitoring Devices

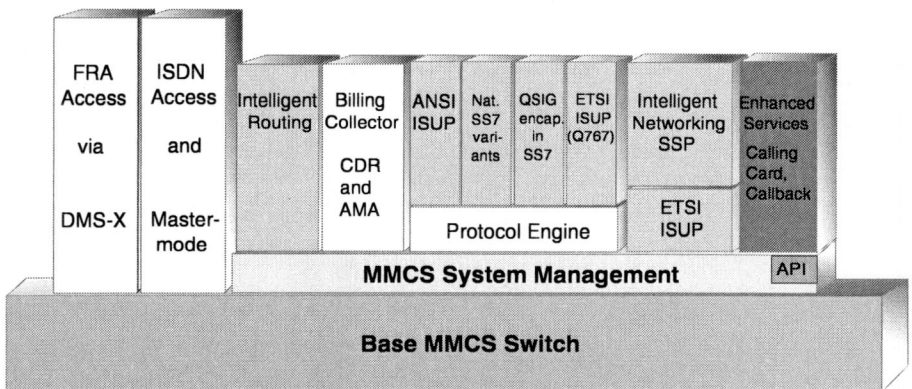
VT520 Teletype Terminals (TTYs) are used for on-site administration of the Core Switch. A 17" SVGA monitor is used for on-site administration of the Application Platforms. There is an integrated controller board residing inside the Applications Platforms. The Motorola 3265 V.34 standalone modem is used to monitor the Core Switch and Application Platforms remotely. This enables carriers to more effectively utilize their technicians' time.

Terminal Server – The Terminal Server is a communication device used by MMCS support to administer and troubleshoot the MMCS system (that is, the Application Platforms, MMS workstation, Core Switch and Meridian Link). The server communicates with the various components primarily through RS-232 serial connections; Ethernet access is supported by a connection with LAN Hub 3. The Terminal Server can be either locally or remotely accessed through a modem.

Chapter 3 – Features and Services

In today's telecommunications environment, new thinking is challenging traditional public networking norms. Carriers are looking for a product with the flexibility to meet many diverse requirements. To help develop competitive carrier solutions, the MMCS is designed with an unprecedented level of service flexibility and options. Speed to market is a critical differentiation between the MMCS and other systems. One of the prime advantages of the MMCS is that a single switch can perform a multiplicity of roles. A carrier's application requirements, and the role they want the MMCS to play in their network, will determine their selection of features and services. To accommodate this diversity, the services that the MMCS can provide have been divided into functional modules. These functional modules, or service options, will be used to provide the features and services required by the carriers and their customers. Each market segment focuses on a subset of the MMCS service modules.

Figure 16
MMCS Service Modularity



The following table shows the three types of target operators and some of the services they will most likely require.

Table 9
 Carrier Service Requirements

Type of Carrier	Pop	SS7	System Management	Base Switching	IR Indirect Access	IR VPN	IR Enhanced Switching	Billing Collector	IN SSP	Enhanced Services
Global Carrier	√	√	√		√	√		√	√	√
International Carrier	√	√	√	√	√			√		√
New National Operator	√	√	√	√	√	√	√	√	√	√

This chapter is organized into the following sections: Global Networking, Mastermode – Point of Presence, Fixed Radio Access, Signaling System Number 7, Routing Mechanisms, Virtual Private Networks, Intelligent Networking Service Switching Point, Enhanced Services, and Billing Services.

The Global Networking section describes network interfaces supported and trunk interworkings. The MMCS acting as a POP is described in the Mastermode – Point of Presence section. The Fixed Radio Access section outlines the MMCS DMS-X solution for wireless service. SS7 connectivity is the focus of the next section. Basic Routing and Intelligent Routing are described in the Routing Mechanisms section. Details of VPN services are provided in the Virtual Private Networks section. The MMCS IN SSP solution is discussed in the next section. The Enhanced Services section describes the MMCS Calling Card and International Callback functionalities. The final section of this chapter discusses billing collection and its related services.

System Management information is contained in Chapter 2.

Global Networking

Multinational companies demand that the network be cost effective and able to support the users and their applications. In addition, their networks must be able to accommodate growth and service evolution, and be able to interface with networks in many countries. Nortel offers the MMCS as a reliable, flexible, and easily accessible networking vehicle capable of handling voice, data, image, text, and video.

The requirements for sophisticated features between a company's major sites have led to significant growth of Virtual Private Networks around the world which support feature transparency (for example, numbering plan and display features). In short, multinational companies demand an end-to-end solution to their communications requirements, a seamless international network providing ubiquitous access to a broad range of functionality and intelligence. By focusing on these diverse customer requirements, Nortel is becoming the industry leader in delivering applications-oriented telecommunications solutions to the world market.

Global networking is being implemented with distributed intelligence. The serving MultiMedia Carrier Switches perform the necessary functions to identify, on a call-by-call basis, the appropriate routing, management information, and tariffing structure.

Network Interfaces Supported

The MultiMedia Carrier Switch supports signaling interfaces and protocols in over 100 countries, providing flexible Customer Premises Equipment and network access using analog and digital signaling systems. These include:

- two- and four-wire analog trunks such as AC15, DC5A, and CEPT/L1
- four-wire E&M type 1 and 2 signaling trunks
- 2 Mbps digital trunks (E1) including ISDN, CAS, R2MFC and Dual-tone Multifrequency (DTMF) signaling
- two-wire Central Office trunks, and
- 1.5 Mbps digital trunks (T1).

The MultiMedia Carrier Switch performs A law to μ law conversion when connections span across regions conforming to differing data bit standards. E1 to T1 conversion is also supported.

The MultiMedia Carrier Switch supports a number of public ISDN systems operating in user mode. These include ISDN Primary Rate Interface (PRI)/Basic Rate Interface (BRI) operating in a number of countries worldwide, as well as ETSI EuroISDN PRI/BRI with specific European variations. Private signaling interfaces supported include Meridian Customer Defined Network (MCDN), DPNSS1, DASS2, ETSI QSIG and ISO QSIG. SS7 variants and ISDN Mastermode streams are also supported as described elsewhere in this Product Guide.

Table 10 on page 51 shows the trunk interworkings supported on the MMCS.

FOR MORE INFORMATION



The *Nortel MMCS Signaling Guide* binder contains detailed information about these supported protocols. Note that the Signaling Guides contained inside this binder are separately orderable for carriers wanting information only about their particular network configuration.

Table 10
MultiMedia Carrier Switch Trunk Interworking

To From	Analog (DIP/DTN)	CAS (DT1)	CAS (DT2)	R2MFC	ISDN/ MCDN	ECMA/ QSIG	ISDN/CO	ETSI PRI/ BRI Slave	ETSI PRI/ BRI Master	DASS2 Slave	DASS2 Master	DPNSS	SS7 ISUP	SS7 TUP
Analog (DIP/DTN)	A	A	A	A	A	A	A	A	A	A	NO	A	A	A
CAS (DT1)	A	A	NO	NO	A	A	A	A	A	NO	NO	NO	A	A
CAS (DT2)	A	NO	AB	A	AB	AB	AB	AB	AB	A	NO	AB	AB	AB
R2MFC	A	NO	A	AC	AC	AC	A	AC	AC	NO	NO	AC	AC	AC
ISDN/MCDN	A	A	AB	AC	ABC	ABC	ABC ¹	ABC	ABC	ABC	NO	ABC	ABC	ABC
ECMA/QSIG	A	A	AB	AC	ABC	ABC	ABC	ABC	ABC	ABC	ABC	ABC	ABC	ABC
ISDN/CO ²	A	A	AB	A	ABC ¹	ABC ¹	N/A	N/A	NO	NO	NO	PG	A ¹	ABC
ETSI PRI/BRI Slave ³	A	A	AB	AC	ABC	ABC	N/A	ABC	ABC	ABC	A (PRI)	ABC	ABC	ABC
ETSI PRI/BRI Master	A	A	AB	AC	ABC	ABC	ABC	ABC	ABC	ABC	ABC	ABC	ABC	ABC
DASS2 Slave	A	NO	A	NO	A	A	NO	A	A	NO	NO	A	A	ABC
DASS2 Master	NO	NO	NO	NO	NO	A	NO	A	NO	NO	NO	NO	A	ABC
DPNSS	A	NO	AB	A	ABC	ABC	PG	ABC	ABC	ABC	NO	ABC	ABC	ABC
SS7 ISUP	A	A	AB	A	ABC	ABC	ABC	ABC	ABC	ABC	ABC	ABC	ABC	ABC
SS7 TUP	A	A	AB	AC	ABC	ABC	ABC	ABC	ABC	ABC	ABC	ABC	ABC	ABC
A = Basic Call B = 64 kbps Unrestricted Data Call C = Calling Line Identification Transmitted PG = Available via a Meridian Customer Defined Network protocol gateway.														

Note 1: Some ISDN protocols have been designed only for standalone connectivities.

Note 2: ISDN/CO Slave includes Numeris VN3/4, 1TR6, SYS12, Swissnet2, and Japan INS1500.

Note 3: ETSI PRI Slave also includes Asia Pacific ISDNs.

Network Access

In general, a Point of Presence can be accessed via leased lines (that is, Direct Access) or via the PSTN (Indirect Access). With Direct Access, the user is connected to a client's CPE which is directly linked to an MMCS using a leased line. The CPE is identified by the CPE ID which is automatically inserted by the MMCS for each incoming call.

With Indirect Access, the network is accessed via the PSTN by a residential PSTN subscriber, a cellular subscriber, or a CPE that has no direct connection to the network. A method of authorizing a user's access to the network is required for all Indirect Access attempts. Validation can be based on an Authorization Code entered by the caller before the called party number, or it can be based upon a screening of the Calling Line Identification (or it may be based on a combination of both methods).

The connection between the PSTN and the carrier's network can take two forms. If an interconnection method is used, there is an agreement between the carrier and the local operator, and their two networks are interconnected, typically using SS7. In this case, a user in the PSTN reaches the carrier network by dialing a short code before the destination number. The PSTN recognizes the short code, and routes the call to the carrier network, including in the setup message the full destination number.

If there is no special agreement between the carrier and the local operator, a Direct Inward Dialing (DID) line can be used for Indirect Access. The MMCS is linked to the local operator's network through a regular DID line; it is viewed by the local operator as a regular CPE. Users access the carrier network by dialing a Directory Number (DN) in the MMCS DID range. Calls terminating on the DN trigger a service such as Direct Inward System Access (DISA), or Authorization Code.

In a POP configuration, DISA is a feature that can also be easily used to provide off-site access to a company's internal network. With DISA, an employee working at home or on the road can dial a simple access code to have their long distance calls automatically billed to their place of business.

Mastermode – MMCS Point of Presence

Overview

The MMCS can operate in an ISDN Mastermode configuration, functioning as a Point of Presence that can control a number of PBXs or other forms of Customer Premises Equipment. In this configuration, the MMCS provides switch-based network services, with all the routing functionality being provided by the Core Switch. The ISDN protocols supported as Mastermode interfaces include DASS2, EuroISDN, INS1500, Italian CAS DTI2, and Numeris.

To operate as a Point of Presence, the MMCS requires three main functionalities: a signaling function, a service function, and an administration function.

The Signaling function involves access signaling and backbone signaling. Access signaling provides all the necessary trunk protocols required to physically connect a carrier's end users to the network. End users require many different protocols throughout the world, and even within a single country, to connect their equipment to a carrier's network. The MMCS must support all of these protocols.

Backbone signaling refers to those protocols that are needed to connect the MMCS to other switches in the network. These protocols have different characteristics than the access signaling protocols. As a Point of Presence, the MMCS acts as a gateway between access signaling and backbone signaling.

The service function consists of routing services and enhanced services. MMCS routing services enable an incoming call to be routed towards its final destination by translating and/or analyzing the Called Party Number and choosing the correct outgoing route.

Enhanced services refer to more complex services that do more than simply route a call. These services bring some added value to the end user (for example, Calling Line Identification).

The administration function includes billing, system management, and network management. As a Point of Presence, the MMCS is responsible for providing all the necessary information to bill for the routing or enhanced services it provides. System management is the administration of all hardware and software components of a particular Point of Presence. Network management involves the administration of all Point of Presences in a carrier's network from a central location.



FOR MORE INFORMATION

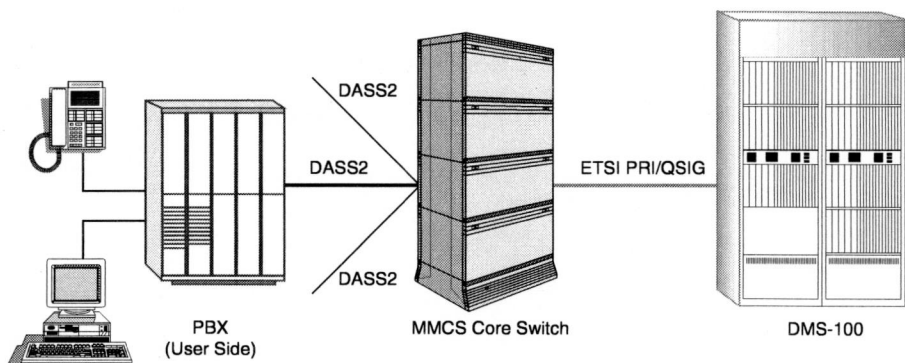
The following subsections provide brief overviews of the supported Mastermode protocols. For more detailed information about any of these protocols, please refer to the *Nortel MMCS Mastermode Signaling Guide*.

DASS2 Mastermode

The DASS2 Mastermode feature enables an MMCS to function as a remote trunk concentrator that allows a Central Office/Public Exchange supporting the ETSI Primary Rate Interface (for example, a DMS) to connect to Private Branch Exchanges (PBXs) via DASS2. In this configuration, ETSI Primary Rate Interface is used as the connectivity between the Core Switch and the network backbone.

To enable the Core Switch to connect to PBXs via DASS2, the MMCS supports the network side or Mastermode of the DASS2 protocol. In addition to supplying this Mastermode functionality, the MMCS also acts as a gateway between the DASS2 master and ETSI PRI. ETSI PRI on the MMCS is referred to as EuroISDN which conforms to ETS 300-102. The MMCS functions as a remote trunk concentrator by using its routing capabilities to concentrate DASS2 links into a smaller number of ETSI PRI, or QSIG, links when it is interconnected to other MMCS switches.

Figure 17
PBX-to-MMCS-to-DMS Network Topology



DASS2 to ETSI Primary Rate Interface Calls

Incoming calls from a PBX to the Core Switch are either in overlap receiving or enbloc mode. The Core Switch routes the calls to the DMS when the routing information is received (that is, using either overlap or enbloc sending).

ETSI Primary Rate Interface to DASS2 Calls

When the Core Switch receives an indication from a PBX that an extension is being rung, ringback tone is supplied to the ETSI PRI trunk from the Core Switch. At this stage, the speechpath between the PBX and the ETSI PRI trunk is not established. When the call is answered at the PBX, ringback tone is removed by the Core Switch and the speechpath is established between the incoming and outgoing trunks, thereby connecting the PBX to the DMS via the MMCS Core Switch.

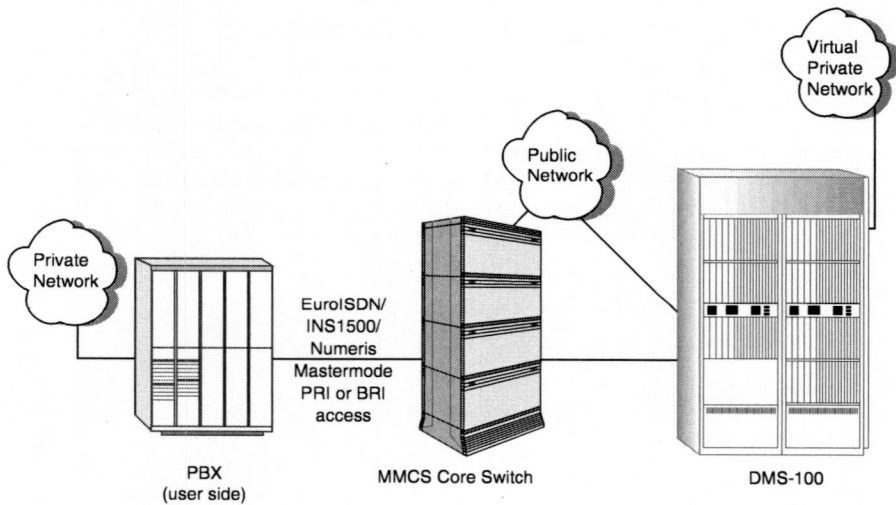
EuroISDN Mastermode

The EuroISDN Mastermode feature enables the MMCS to function as a Point of Presence. The Core Switch connects to a PBX using the network side of the ETSI EuroISDN protocol, which is referred to as the Mastermode protocol. The network side of the EuroISDN protocol provided on the Core Switch has the same level of interworking with other trunk interfaces (for example, other ISDN Central Offices, MCDN, Digital Private Network Signaling Systems – DPNSS, Digital Access Signaling Service 2 – DASS2, and R2 Multifrequency Compelled) as is currently provided on the user side of the EuroISDN protocol.

User-to-User Transparency

This feature provides the transparent transport of User-to-User (UUS) information within EuroISDN call control messages on both Basic Rate Interfaces (BRIs) and Primary Rate Interfaces (PRIs) during call setup and clearing. The service allows a called user and a calling user to exchange a small amount of data over the D-channel of EuroISDN trunks, the data being in a USER_USER Information Element (IE) within the call control messages (note that this subfeature also applies to INS1500 Mastermode).

Figure 18
EuroISDN/INS1500/Numeris Mastermode Network Topology



INS1500 Mastermode

The INS1500 Mastermode feature enables the Core Switch component of the MMCS to act as a POP using the network side of the INS-Net protocol. The Core Switch connects to a Private Branch Exchange (PBX) using the network part of the INS-Net protocol for Japan.

The network side of the INS-Net protocol provided on the Core Switch has the same level of interworking with other trunk interfaces (for example, other ISDN Central Offices, MCDN) as is currently provided by the user side of the INS-Net protocol. In addition, it provides the same level of feature interworking.

Italian CAS DTI2 Mastermode

The Italian DTI2 Mastermode feature has been introduced to provide support for the network side of the Italian DTI2 protocol based on Norma Tecnica N.701. It is designed to enable an MMCS node to connect end user nodes configured with Italian DTI2 links.

This feature enables the MultiMedia Carrier Switch (MMCS) to receive End of Selection (EOS) signals on the user side of the Italian DTI2 protocol for basic calls, and on the network side of the Italian DTI2 protocol for DTI2 gateways.

Numeris Mastermode

The Numeris Mastermode feature enables the Core Switch component of the MMCS to support the network side of the Numeris protocol. The Core Switch connects to Private Branch Exchanges (PBXs) using the network part of the Numeris protocol. Both Basic Rate and Primary Rate Interfaces are supported. The network side of the Numeris protocol provided on the MMCS has the same level of interworking with other trunk interfaces as is provided by the user side.

This feature takes into account different stages of evolution of the Numeris network as follows:

- this development enables the MMCS to be connected to VN4-type terminal equipment (VN4 is step 4 in the evolution of the French public network), and
- it also enables the MMCS to be connected to VN6-type terminal equipment which will be supported in the Numeris network commencing in the first quarter of 1998 (VN6 is step 6 in the evolution of the French public network).

One of the VN4 or VN6 options must be selected during feature configuration time.

Additional Mastermode Protocols

Additional Mastermode protocols will be developed as market demand dictates.

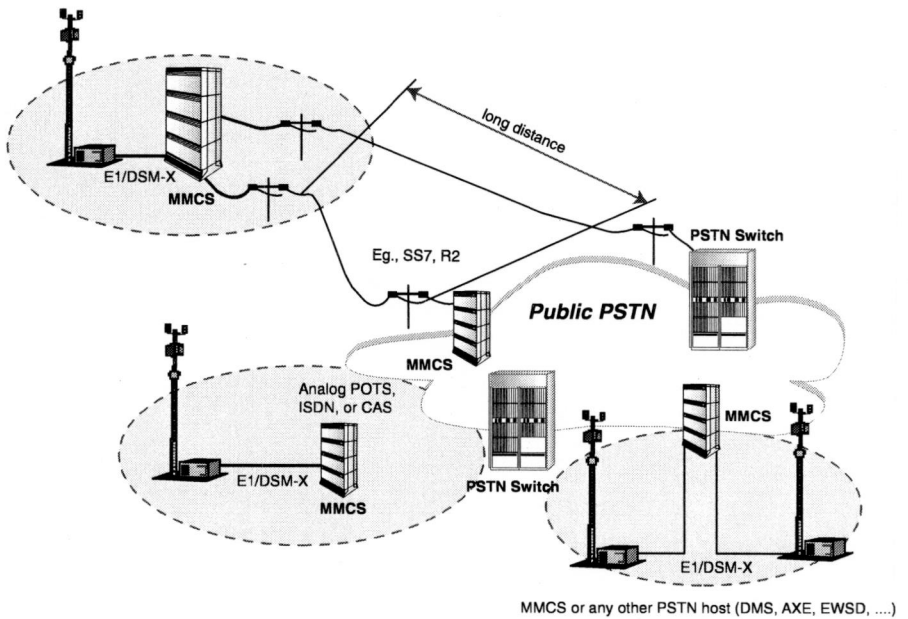
Fixed Radio Access

The MMCS supports both Proximity I and T wireless applications. Not only does the MMCS provide multiple switching alternatives, it can provide feature-rich terminal portability with toll quality voice, allowing carriers to serve the growing number of wireless customers around the world.

The addition of Fixed Radio Access to the MMCS product portfolio increases the competitive strength for carriers in the marketplace. There are several applications of this exciting service. In several regions around the world, there is no common concentrating interfaces shared by the PSTN host exchange and the FRA Base Station. In these places, the MMCS can be used to concentrate interfaces between Fixed Radio Access (FRA) base stations and the PSTN.

The following illustration shows how the MMCS Fixed Radio Access offering can be deployed.

Figure 19
MMCS Fixed Radio Access



Other applications include migrating existing networks and supporting wireless connections in the local loop or supporting local switching in case of backhaul failure. Often FRA Base Stations are used to offer services to remote and inaccessible communities. Most of the traffic is local, and in the case of a trunk failure, the whole serving area will be without service. Because the MMCS supports local routing, using the MMCS provides a solution that is more reliable and robust.

In all situations, the MMCS can be directly connected to FRA equipment without having to use a MUX or numerous line cards. In 1998, the MMCS will support the V5.2 protocol.

Signaling System Number 7

Signaling System Number 7 (SS7), also known as Common Channel Signaling Number 7, is an overlay network of high-speed signaling links interconnecting MultiMedia Carrier Switches and other compliant switching nodes, and centralized network databases. Replacement of existing in-band signaling technology with SS7 signaling results in immediate trunking efficiencies. More importantly, SS7 transport serves as the base for an entire new set of beneficial revenue-generating and cost-reducing services.

Like Primary Rate Interface, SS7 provides ISDN services and features throughout the public network; however, it separates call signaling from the voice/data path so that interoffice signaling is exchanged over a separate signaling link. SS7 provides a higher bandwidth and reduced call set-up and tear-down times than traditional Channel Associated Signaling (CAS) methods.

Services offered through the SS7 signaling network are based primarily on two characteristics:

- structured layer architecture, and
- the use of high-speed digital signaling links.

The inherent independence of integrated voice and data from the existing voice communications network enables its rapid evolution into a highly intelligent entity. Today, SS7 is a main component of ISDN, with ISDN and Primary Rate technology providing access to the customer premises switch, and SS7 providing the network signaling, supporting inter-switch ISDN service transparency.

SS7 separates the voice/data and signaling traffic, thereby enabling digital switches to communicate with each other in the most cost-effective manner. To reduce call setup costs and to optimize the voice and data channels, SS7 is rapidly replacing Channel Associated Signaling with an infrastructure of high-speed signaling data links. SS7 delivers all the capabilities for call establishment, call clearing, error handling, network operations, and maintenance and database enquiries, while facilitating new revenue-generating services across the network. The MMCS is equipped with signaling capabilities that enable it to originate or terminate SS7 messages and queries.

The main functionalities that SS7 provides are:

- Backbone switches such as the DMS communicate with each other using SS7 protocols, such as Integrated Services User Part (ISUP). The overall VPN architecture has the same requirements as a public network in terms of call volumes, redundancy and reliability.
- In order to receive calls from national PSTNs, the MMCS must be able to receive more than just the four or five digits used by the PSTN to address a PBX with a Direct Inward Dialing (DID) interface. With SS7, any number of digits can be received so long as the MMCS interface has been registered with a specific point code in the PSTN. SS7 point codes for addressing the PSTN are totally separate from the ones used for addressing the VPN.
- For calls from the MMCS to the PSTN, the Calling Line Identifier is not screened by the SS7 protocol, whereas it is screened by the regular DID interface. Therefore, the Calling Line Identifier can be used to convey the real call originator identification, rather than merely the DID interface's Calling Line Identifier.
- R2MFC, the protocol traditionally used to reach international gateways, is significantly slower than SS7.
- Networks such as Global System for Mobiles (GSM) can only be reached by SS7.

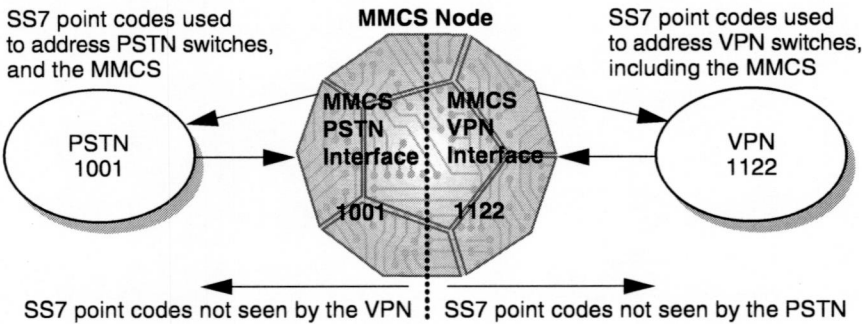
Currently, only associated mode signaling is supported on the MMCS, meaning that signaling and speech are conveyed over the same physical links. Other signaling modes (for example, quasi-associated or independent) will be supported in subsequent product releases.

Table 11
Supported SS7 Protocol Variants

Market	Protocol Variant	Standard
<i>ISUP</i>		
International	ETSI ISUP Version 1	ITU Q.767/ETS 300.121
International	ETSI ISUP Version 2	Q.767 (1991)
<i>TUP</i>		
United Kingdom	BTUP	BTNR 146 and 167 Version 3.0
France	SSUTR2	VN4 and VN5

An SS7 network provides alternate routes between nodes which form a hierarchical structure of redundancy to protect against the failure of signaling links or nodes. As an SS7 node, the MMCS must be assigned a point code. Point codes take two forms: Destination Point Code, and Originating Point Code. Point codes are used to define the network to which the node belongs and provide addressing functionality. With SS7, any number of digits can be received by the MMCS, so long as the MMCS interface has been registered by a specific point code in the PSTN. SS7 point codes used for addressing the PSTN are totally separate from the ones used for addressing the alternate network, as shown in the following illustration.

Figure 20
SS7 Addressing in the PSTN and the VPN



An MMCS can use SS7 to connect to the VPN backbone, to an International gateway, to the PSTN or to an alternate operator. In the MMCS, an SS7 application residing in the Application Platform is used to supply the SS7 functionality.

MMCS SS7 System Composition

The physical interface, as well as the protocol stacks, are provided by the MMCS Application Platform (AP) in association with the Core Switch. SS7 protocol capabilities are implemented on the MMCS through an application running on the Application Platform. The SS7 application converts ISDN 7sig signaling (from/to the Core Switch) to an SS7 ISUP/TUP signaling protocol (from/to the SS7 network). In addition, the SS7 application offers automatic maintenance, channel negotiation and trunk recovery capabilities to ensure optimum network performance.

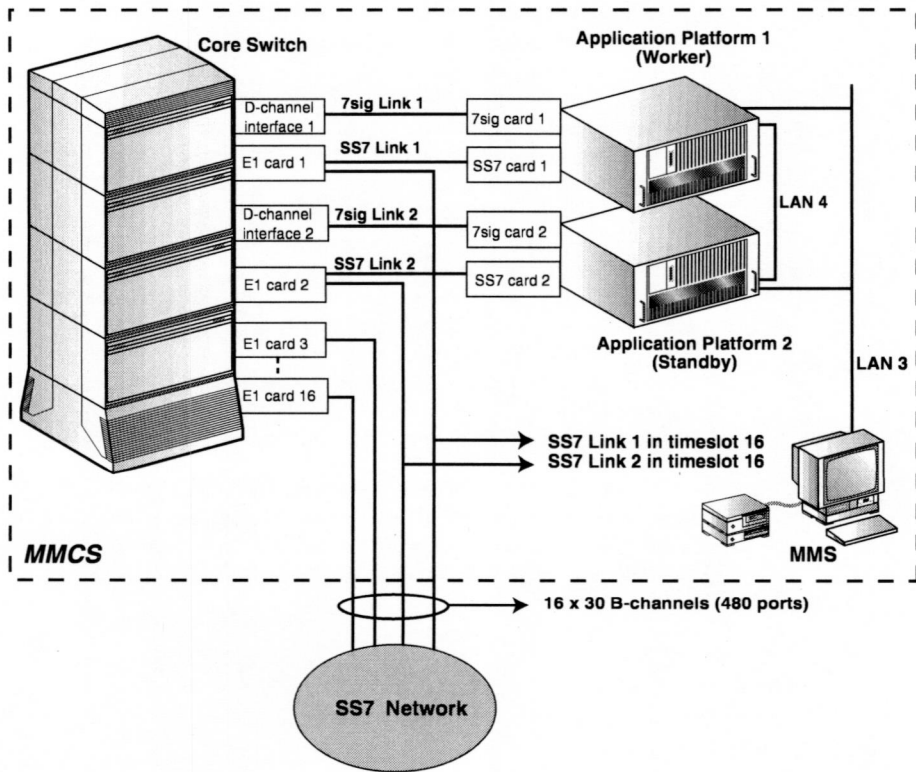
Signaling links are organized into a linkset, which consists of two 64 kbps links directly interconnecting an MMCS to another signaling point. A linkset is made up of two signaling links which control up to 16 E1/T1 interfaces. Each route uses a linkset to carry the signaling messages.

The MMCS is connected to the SS7 network through E1 (2.048 Mbps) or T1 (1.544 Mbps) trunks. At least two E1s/T1s and up to 16 E1s/T1s can be connected for a single SS7 linkset. E1s carry 30 B-channels (that is, 64 kbps voice or data) each. The first two E1s also carry one 64 kbps SS7 channel in timeslot 16 (to support load-sharing functionality, two SS7 links are necessary per linkset). T1s carry 24 B-channels (that is, 56 kbps voice or data). The first two T1s carry one 56 kbps SS7 channel in timeslot 24.

The SS7 link between two MMCS nodes is referred to as a routeset. A routeset provides the connection between two linksets (that is, one linkset at each node). Routesets are used to provide redundancy between the originating node and destination node.

The Core Switch 7sig interface (one port of an MSDL card) is connected to a new 7sig card in the AP by an RS-422 serial interface cable. The application software converts 7sig to SS7 and vice versa. An SS7 card, also residing in the AP, is connected to a Core Switch E1/T1 interface by an RS-422 serial interface cable. A second Core Switch 7sig interface and 7sig card in the AP is available as a backup D-channel. In addition, two APs are used to maximize service availability: a Worker AP and a Standby AP. If there is a failure in the Worker AP, calls are automatically routed to the Standby AP.

Figure 21
 SS7 Hardware Configuration (E1 Associated Mode)



**FOR MORE INFORMATION**

If you require more information about SS7 connectivity on the MMCS, please see the *Nortel MMCS SS7 Signaling Guide*.

Virtual Private Networks

Virtual Private Networks are managed by the carrier and deliver voice, data and advanced services cost effectively across the network. Each end user corporation shares switching, transmission and bandwidth with other end user corporations, but maintains their own private dialing plans and services.

The MMCS delivers both a switch-based and an IN-based Virtual Private Network service or a hybrid of switch- and IN-based solutions.

Nortel has extensive experience in delivering Virtual Private Network services, and recognizes that there is no single Virtual Private Network solution, but, rather, a set of building blocks that can be used to respond to a customer's unique requirements. The MMCS acts as an entry-level vehicle capable of providing many networking solutions. It can be viewed as another networking building block, which interoperates with Nortel's leading portfolio of networking products including the DMS-100, DMS-250 and Magellan Passport, and a wide range of transmission offerings.

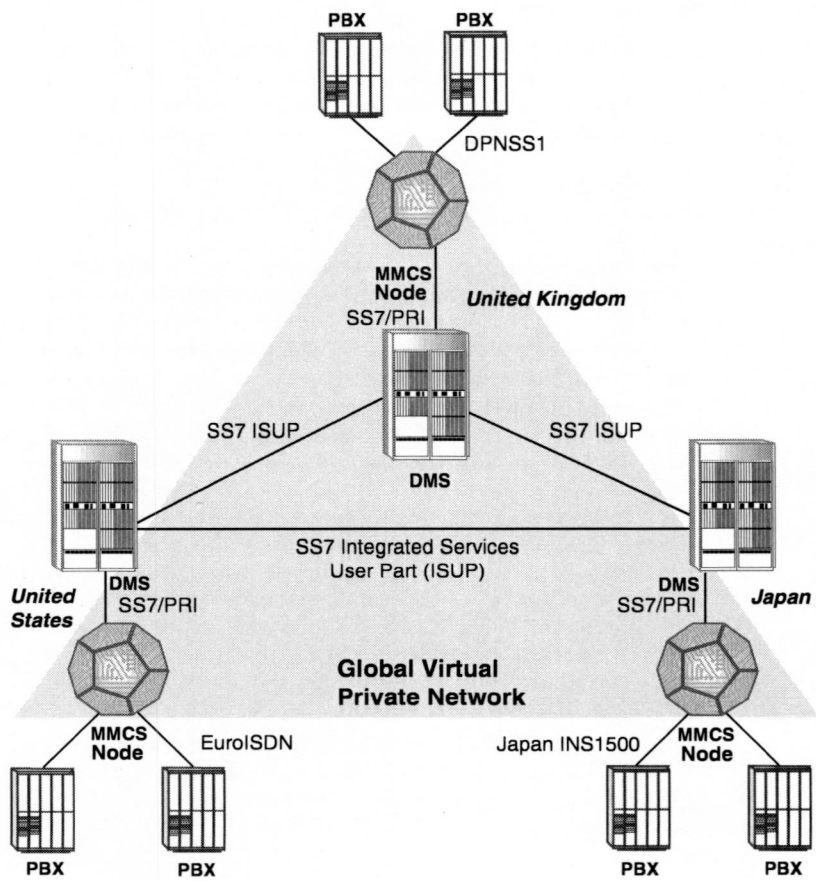
From an enterprise viewpoint, the scope of Virtual Private Network service relates to the provision, within the public domain boundary, of internetworking services between multiple customer premise networks. The service is considered "virtual" because end users share switching, transmission, and billing management with other end users, but still keep their own private dialing plans and services.

Closed User Groups

A company that operates several CPEs may choose to have all members form a Closed User Group. A Closed User Group may share one or several common dialing plans, which are not accessible to other Closed User Groups offered by the carrier.

The MMCS offers multiple dialing plans which include from four- to ten-digit dialing, and a speed dial or hot line option. Up to a maximum of 400 Closed User Groups are supported. By maintaining separate customer profiles in the IR or IN database, end users are ensured of having a secure network.

Figure 22
Single Company Closed User Group within a VPN



Access Types

Call types are differentiated by access type and by the way a dialed number is translated. The following table shows the MMCS call types.

Table 12
MultiMedia Carrier Switch Access Types

Number Dialed	Closed User Group Number	Closed User Group Number	PSTN Number	PSTN Number
Number Translated	Closed User Group Number	PSTN Number	Closed User Group Number	PSTN Number
From				
Direct Access	OnNet ToOnNet	OnNet ToVirtualOnNet	OnNet ToForcedOnNet	OnNet ToOffNet
Indirect Access	OffNet ToOnNet	OffNet ToVirtualOnNet	OffNet ToForcedOnNet	OffNet ToOffNet

One additional call type can be distinguished. If, at a terminating MMCS, a call cannot reach the destination CPE and is rerouted through the PSTN, this type of call is referred to as Direct Termination Overflow.

Routing Mechanisms

Overview

Two routing mechanisms are available with the MMCS: Basic Routing and Intelligent Routing. Either of these routing options may be ordered depending upon the needs of the carrier.

Basic Routing provides Virtual Private Network services with Direct Access and long distance services using either Direct or Indirect Access. Enhanced capabilities are offered through the use of the Intelligent Routing (IR) feature. In addition to the Basic Routing capabilities, Intelligent Routing provides Calling Line Identification validation, Virtual On-net and Forced On-net access, and Virtual Private Network Indirect Access.

The following table summarizes the routing options provided by the MMCS.

Table 13
MMCS Routing Options

Call Type	Direct Access	Authcode	CLI Validation
Long Distance	Basic	Basic	IR
On-net	Basic	IR	IR
Off-net	Basic	IR	IR
Virtual On-net	IR	IR	IR
Forced On-net	IR	IR	IR

Basic Routing

To form a seamless network, the MMCS acting as a POP, and the backbone switches share a common carrier dialing plan. This architecture does not necessarily require that all POP switches be MMCSs. Likewise, the POP has no knowledge of the backbone switches. The only prerequisite is that the backbone switch be able to communicate with the POPs using a common protocol (for example, ISDN QSIG, EuroISDN, or SS7) and that they share the same carrier dialing plan.

Using Electronic Switched Network (ESN) routing tables, the Core Switch implements the carrier's dialing plan. The Electronic Switched Network feature implements a Uniform Dialing Plan common to all nodes in the network in a cost efficient and easy-to-use manner. It provides the means of controlling the time of day that access to a trunk (or group of trunks) is allowed, and automatically selects the least-cost trunk route available to complete the call. This is accomplished using the following ESN features: Network Alternate Route Selection; and Flexible Numbering Plan.

The destination digits are analyzed, and based upon the information contained in the tables, a decision is made regarding which outgoing route and trunk to select. A manipulation can optionally be applied to the digits before they are outpulsed.

A carrier's dialing plan must fulfil the following requirements:

- A carrier number must be non-ambiguous and must have network-wide significance no matter which MMCS translates it.
- Each number in the network must be reachable with the format.

Depending upon the flexibility and level of service required, the following two requirements may also be necessary:

- The carrier's dialing plan must limit the amount of configuration required, especially on the Core Switch. The plan must be flexible enough to allow easy configuration changes.
- Calls encountering congestion at the MMCS terminating node must be subject to rerouting (that is, the number received by this node must be generic enough to implement Direct Termination Overflow).

There are several dialing plans that are supported on the MMCS including: international public format, unique carrier format, and dual carrier format. In addition, other carrier number formats can be used to provide additional information should it be required.

Bearer Capability-Based Routing – Bearer Capability-Based Routing enables outgoing calls to be selectively routed (over Central Office, Direct Inward Dialing, or TIE trunks for ISDN routes, and Integrated Digital Access trunks for DPNSS and DASS2 routes) based upon the Bearer Capability of the call. Any ISDN PRI or ISDN BRI route can be configured to be dedicated to handle voice calls only, data calls only, voice and 3.1 KHz audio, data and 3.1 KHz audio, or voice, data and 3.1 KHz audio.

Intelligent Routing

Introduction

The Intelligent Routing feature used by the MMCS enhances the Basic Routing capabilities that are provided by the Core Switch. Intelligent Routing is an inexpensive proprietary IN-based implementation for VPN, Authcodes and CLI screening. These services have been identified as the most important ones for carriers. More features will be added in later releases based on market and customer demands.

The following table provides a comparison between IR and IN.

Table 14
IR vs. IN Comparison Matrix

IR Solutions are Preferred When:	IN Solutions are Preferred When:
The network is made up of MMCS nodes only	The network is comprised of other switches (for example, the DMS or other vendors)
Existing services are a good fit with customer needs	Existing SCP services (for example, ServiceBuilder or third party products) are a good fit with customer needs
It is desirable to provide the service locally	The carrier desires to develop their own services
	In order to avoid vendor "lock-in", the customer desires a solution based on international standards

IR Functional Description

Calls requiring interaction with applications initiate a trigger which leads to a message being sent to the application residing on the Application Platform. The application translates the message to determine the appropriate destination number. The Core Switch waits for a response from the application before routing the call to the destination number.

Translation tables required to process calls are stored on a database on the Application Platform. A Centralized Database Server, typically one per network, is used as a master database for updating and managing all databases in the network. The use of translation tables in the AP not only enables much of the Core Switch's call processing to be off-loaded, it also enables the carrier to easily customize the database for its different customers. It is even possible for a certain number of the calls to be routed directly to the backbone based on the first digits received, without terminating on an Application Platform, thereby saving both resources and processing time.

Client's numbering plans are configured in an Intelligent Routing (that is, Oracle) database residing on an Application Platform. Numbering plans can be customized in many ways; each customer may configure several types of numbering plans for their own purposes (for example, one private, and one public). Each client's Customer Premises Equipment (CPE) can have its own prefixes that are used to access the various numbering plans and that client's unique Speed Call lists. Inside, the network numbers are transported in specific formats that are never seen by the client (that is, carrier numbers), which themselves can take many forms.

In all cases, a call terminates only once on the MMCS serving the CPE Private Branch Exchange (PBX). This original MMCS determines the full digit manipulation required to access the desired party within the network. To make this happen, all MMCS systems in the network need to have the same information. A synchronization mechanism between the different databases is provided to achieve this functionality.

Statistically, call loads should be shared equally between the two Application Platforms. This depends, however, upon the probability law relating to incoming call arrivals. If a failure in one of the subsystems occurs, calls are automatically rerouted by the Core Switch to the other subsystem.

Both Direct and Indirect Access give admission to a routing service which analyzes the dialed number, translates the digits to map the carrier dialing plan, and provides the CDR information. The Core Switch is then responsible for routing the call to the backbone according to the carrier dialing plan.

The Intelligent Routing application:

- identifies the access control method (that is, Direct Access or Easy Access using CLI screening or Authcodes)
- provides access control or security
- routes incoming calls using MMCS dialing plans (that is, queries a local Oracle database to obtain destination routing addresses)
- translates the client's dialing plan into the carrier's dialing plan, and
- collects real time and historical statistics, and forwards this information to the CDR application to provide Call Detail Records that can be used for billing purposes.

Table 15
MultiMedia Carrier Switch Routing Mechanisms

Mechanism	Description
Carrier Dialing Plan Routing	For the Core Switch to route calls according to the carrier dialing plan, a Basic Routing (that is, Electronic Switched Network [ESN]) mechanism is used.
Access and Control Routing Services	The Intelligent Routing application provides both the Access Control methods (that is, Direct Access, or Indirect Access validation) and the Routing Services (that is, long distance, VPN).
MultiMedia Carrier Switch Intelligent Networking Foundation (MIF)	This Core Switch feature is used to analyze the incoming call and to determine whether to trigger the Intelligent Routing application, or whether the call can be directly routed by the Core Switch. Calls requiring external service initiate a trigger which leads to a message being sent to the IR application residing on the Application Platform. The application translates the message to determine the appropriate destination number. The Core Switch waits for a response from the application before routing the call according to the destination number. The MIF feature determines if the call should trigger an internal service or be routed directly, and formats a parameter passed to the application (that is, Dialed Number Identification Services [DNIS]). Note: MIF is also used to trigger the IN application.

Intelligent Routing Database Dimensioning – The Intelligent Routing database is scaled to store the amount of data required to configure the following four types of VPN clients:

- clients with 200 sites and 50 000 users in total (up to 50 such clients)
- clients with 100 sites and 5 000 users in total (up to 100 such clients)
- clients with 70 sites and 5 000 users in total (up to 200 such clients), and
- clients with 50 sites and 1 500 users in total (up to 400 such clients).

It is also assumed that for each client, up to one percent of users are moving users (that is, are OnNet users requiring an entry in the exception table), 10 percent of CPE sites are VirtualOnNet, and 10 percent of users can be reached using a Speed Call List, and that there are 10 prefixes per CPE.

Table 16
Capacity Requirements

Closed User Group Category	Number of Closed User Groups	CPE per Closed User Group	Users per Closed User Group	% of Moving Users	% of Virtual OnNet (% of CPE)	% of Speed Call Lists	Prefix CPE	Dialing Plans per Closed User Group
Category 1	50	200	50 000	1%	10%	10%	10	200
Category 2	100	100	5 000	1%	10%	10%	10	100
Category 3	200	70	5 000	1%	10%	10%	10	70
Category 4	400	50	1 500	1%	10%	10%	10	50

Based upon the requirements depicted above, the following table shows how the database can be scaled.

Table 17
Database Capacity

Closed User Groups	CPE per Closed User Group	NW CPE ID	Total Users	Percentage of Moving Users	Percentage of Virtual OnNet of CPE	Total Exceptions	Percentage of Speed Call Lists	Total Speed Call Entries	Total DEST Entries	Prefix per CPE	Total Prefixes	Total ForcedOnNet
50	200	10 000	2 500 000	1%	10%	26 000	10%	250 000	286 000	10	100 000	10 000
100	100	10 000	500 000	1%	10%	6 000	10%	50 000	66 000	10	100 000	10 000
200	70	14 000	1 000 000	1%	10%	11 400	10%	100 000	125 400	10	140 000	14 000
400	50	20 000	600 000	1%	10%	8 000	10%	60 000	60 000	10	200 000	20 000
Total												
750		54 000	4 600 000			51 400		460 000	565 400		540 000	54 000

The database should also be able to store up to:

- 1 000 domains.
- 200 countries.
- 10 000 regions.
- 75 000 regional manipulations.
- 2 000 000 CLIs.



FOR MORE INFORMATION

If you would like more information about Intelligent Routing, please see the *Nortel MMCS Intelligent Routing Guide*.

Centralized Database Server

The Centralized Database Server (CDBS) is used as a repository for the Intelligent Routing database. Typically, one is configured per network which may or may not be collocated with the switch. It also:

- handles Intelligent Routing database provisioning sessions
- propagates updates to the different MMCS nodes at a user-configurable refresh time (for example, immediately, once every hour, once every day), and
- cuts database tapes either to load new MMCS nodes or reload faulty nodes.

A Centralized Database Server acts as the master of all MMCS databases. Data propagation is used to distribute the data updates from the CDBS to each MultiMedia Carrier Switch's primary IR Application Platform.

Both the process of provisioning the system and the master database are decoupled from the MMCS. Ensuring that live traffic database requests are not performed on the same platform as the provisioning results in cost reductions, real time and automatic synchronization, and enhanced security.

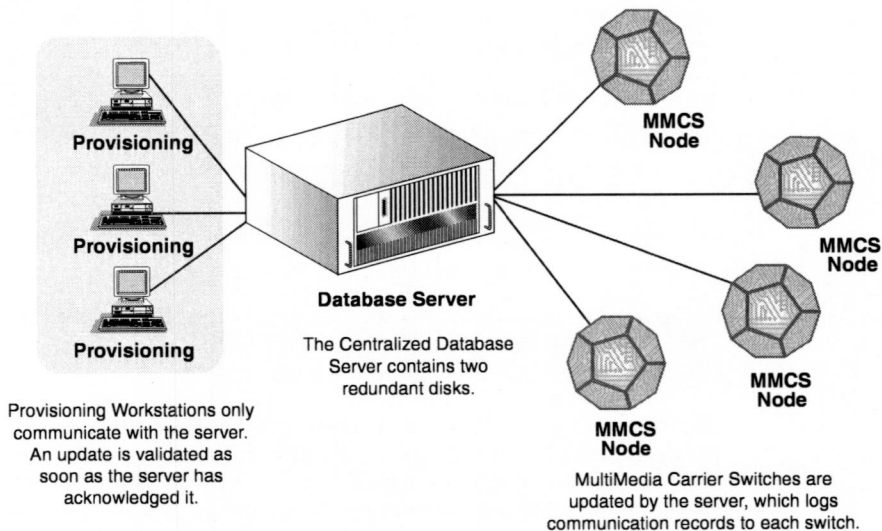
Provisioning Workstations provide a Graphical User Interface (GUI) to populate the database located on the Centralized Database Server. These updates are then propagated to the databases on all MMCSs through a TCP/IP link. This process is called "replication". The Provisioning Workstations also provide screens to monitor the replication and to take recovery actions if necessary.



FOR MORE INFORMATION

If you would like more information about how to operate a Provisioning Workstation, please see the *Nortel MMCS Provisioning Workstation User Guide*.

Figure 23
Provisioning the Centralized Database Server



When an update has been validated on the server, it becomes the server's responsibility to ensure that the update is propagated to each MMCS. The server then sends requests to each MMCS and maintains a record of link status to each MMCS, as well as a record of pending database requests in each direction.

Table 18
Centralized Database Server Attributes

Attribute	Description
Database Server	Same platform as the MultiMedia Carrier Switch Application Platforms (that is, DEC Priors). The Database Server can be collocated on an MMCS node, but cannot share an Application Platform with another application (that is, IR, CDR, SS7, or IN SSP). 50 MB package size; up to 3 GB data size.
Provisioning Workstations	The Intelligent Routing provisioning software runs on either an SVGA terminal, on an X Terminal, or on the MMS Workstation (that is, Sun).
Connectivity	TCP/IP between the Provisioning Workstations and the Centralized Database Server; TCP/IP between the Centralized Database Server and the MMCSs.
Redundancy	Two hard disks are provided for redundancy.

Generally, three types of object hierarchies can be configured on the Centralized Database Server:

- 1 Site-dependent data, including prefixes. This form of data binds the physical (that is, carrier) network with the logical (that is, the Virtual Private Network client's) network.
- 2 Private Dialing Plans. Each Closed User Group (CUG – usually one per corporation) can define several private dialing plans such as Speed Call Lists. These private plans are specific to a particular client and thus are unavailable to other Closed User Groups.
- 3 Shared Dialing Plans. Dialing plans such as local, regional or international PSTN can be shared by several Closed User Groups. These dialing plans can also be used to provide services to a carrier's clients (for example, directory assistance).

For each hierarchy, it is easy to navigate from one level to another by simply clicking a button. However, only one level is active at a time. It is also possible to switch back and forth from one object hierarchy to another by using the "Configuration" menu.

Intelligent Networking

The MMCS Intelligent Networking application follows the same principles as the Intelligent Routing concept. The main difference between the two is that in an IN configuration the database and the services are centralized and conform to industry standards (that is, ETSI INAP). Unlike non-standardized implementations, IN does not require service upgrades to every single switch once a service is added or modified. Standard solutions enable a carrier to create multi-vendor network architectures.

The MMCS implements an IN architecture with the MMCS acting as an SSP capable of triggering interactions with a Service Control Point (SCP). The separation of call processing and the delivery of services is at the heart of the IN conceptual model. This makes it easier for an operator to both create and manage new advanced services. It also allows an operator to work with Nortel to forge creative, individual service solutions.

The implementation of an open standard signaling system, using TCAP and ETSI INAP enables the MMCS to originate and terminate queries to any INAP-compliant SCP service database. This, in turn, allows the MMCS to offer services over multi-vendor or open systems IN networks.

IN implementation on the MMCS gives operators several advantages regarding the way in which they implement a service for their customers. Specifically, the separation of service and call processing logic makes the configuration, deployment and modifications of services quicker and easier. The use of standard, re-usable software modules for service logic reduces development time and cost. Features that have already been developed and tested can be combined to provide new services depending upon an operator's unique requirements. All the time, the risk in deploying new or changed services is minimized.

The following table demonstrates how IN services can be implemented in phases on the MMCS.

Table 19
IN Evolution Strategies

Strategy	Description
Distributed Service Network	Services need to be deployed on each node in the network. Different vendors switches are often incompatible, leading to a dependence on a single vendor. High maintenance and cost of ownership.
Distributed IN Network	Transparent services offered across a number of identical nodes. Ability to provision, plan and administer nodes remotely. Decreased cost of ownership; however, systems are often proprietary leading to high initial price and reliance on a single vendor.
Open IN Network	Services are deployed centrally from an SCP. SCP controls the switches from a central location. Open standards ensure that any vendor's equipment will interwork with any other vendor's equipment. Service creation and deployment are significantly cheaper and can be implemented with a much higher degree of flexibility.

MMCS SSP Configuration

In the IN functional architecture, an SSP is used to provide the trigger mechanism that causes IN processing to be launched. It also delivers the Service Switching Function that is used to provide the interface between the basic call processing and the service logic processing. The SCP, in turn, executes the service logic programs that implement IN services and provides access to customer and service data. The MMCS SSP is compatible with Nortel's ServiceBuilder SCP, as well as other vendors' compliant SCPs.

Like SS7, the MMCS SSP configuration consists of the Core Switch and two Application Platforms. On each AP resides a complete SS7 stack (that is, MTP1, MTP2, MTP3, SCCP, TCAP). The TCAP, SCCP and MTP3 modules are organized in a worker/standby configuration, with only one active at any given time on an AP.

The IN application on each AP communicates with the active TCAP module through TCP sockets. For all calls triggering the Detection Point in the MIF feature configured on the Core Switch, call control is given to the IN application through the Meridian Link Module and the corresponding Control DN (CDN). While a call is being handled by the IN application, call processing is suspended on the Core Switch.

The IN application on the AP then constructs and sends an INAP InitialDP towards the ServiceBuilder SCP with the following parameters: Service key, called party number, calling party number. This is done by sending the appropriate information to the active TCAP/SCCP module. The SCP answers with an INAP Connect message containing the destination routing address and optionally additional service definition parameters. This is a simplified view as there often is much more interaction between the IN application software and the SCP depending upon the complexity of the service being provided. For example, an Intelligent Peripheral may be used to play announcements and/or collect digits for services such as Calling Card.

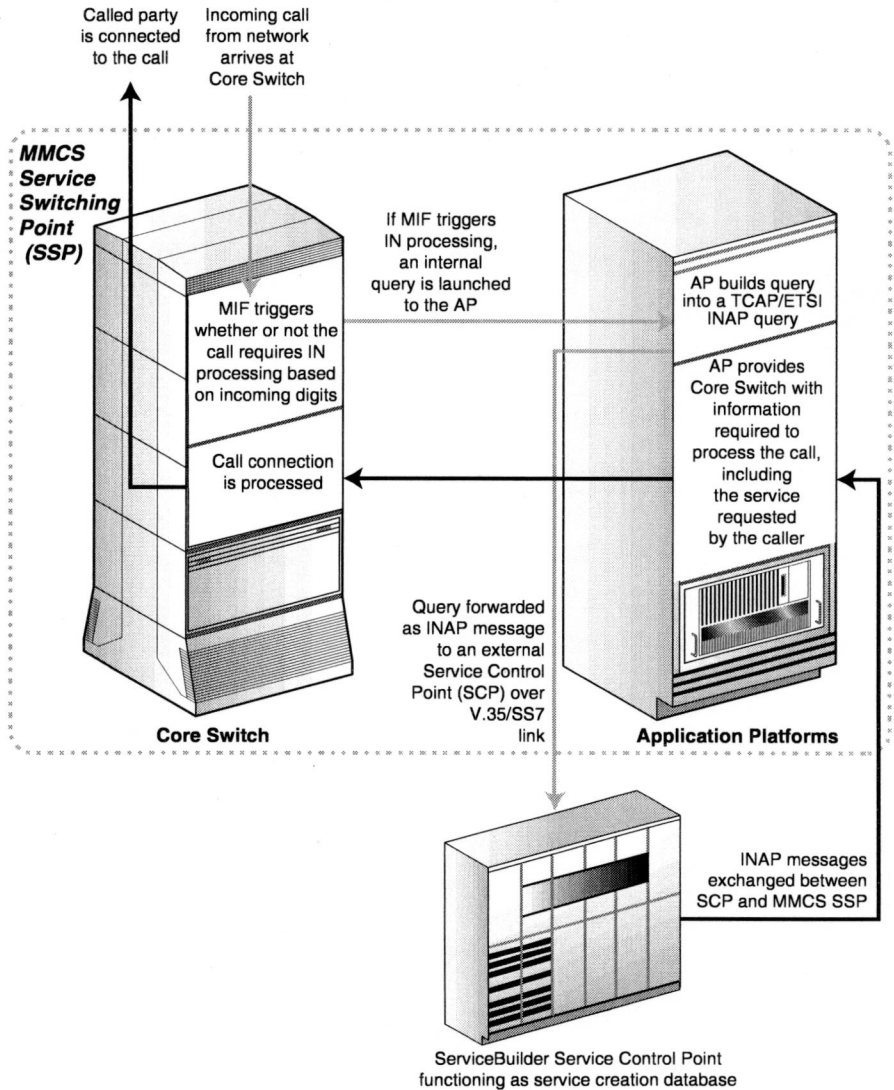
FOR MORE INFORMATION



This section only provides a brief description of the MMCS SSP IN functionality. For more detailed information about how to implement IN on the MMCS, please refer to *Nortel MMCS IN Networking Guide* which will be made available later this year.

The following illustration shows a example of a call flowing through an MMCS IN environment.

Figure 24
MMCS SSP Configuration



Enhanced Services

Calling Card

The implementation of enhanced services on the MMCS provides for flexible service definitions used for such services as Calling Card. Calling Card service opens another door of opportunity for the operator. A caller with an account card can make a call from any phone and have the call charged to the account. Although originally intended for business customers, this service is also becoming more popular for residential subscribers. Voice prompts are used by the MMCS to step a customer through the Calling Card procedures making it a simple service for people to use. Least-cost routing, prepaid debit cards, fraud prevention, and security features are also used to enhance the value of this service.

The MMCS Calling Card feature provides:

- Multiple card types
- Multiple billing options
- Selectable call flows
- Card regeneration (“replenishment”)
- Speed Dial administration, and
- Callback destination management.

Prepaid Debit Card

With the worldwide growth in popularity of the Prepaid Debit Card, it is important to elaborate on the features available with this version of the MMCS Calling Card. Each Calling Card account can be credited with a desired amount of prepaid fees and each call is rated and entered as a debit against the prepaid account. When the account reaches zero, no calls are permitted until the balance is replenished.

Debit balance can be currency, time or units. The balance can be replenished when required. An advanced Audiotex program presents callers with the appropriate prompts to manage the account and replenishment process.

Callers access Debit Card features by calling a designated number and entering a password. The system prompts the user on how to operate the various features.

Reorigination quick keys are also available to allow multiple calls within a single session.

Postpaid Invoice Card

Alternatively, a Calling Card account can be configured as a credit account with or without a credit limit.

When appropriate, billing records are extracted and processed externally.

Provisioning – Card applications, user profiles, rates, etc., can be configured through a menu-driven interface.

Lots – To ease the management of large groups of homogeneous cardholders, users sharing the same attributes (for example, card type, balance, expiration date, etc.) can be defined by lots.

Multiple Language Support

The Calling Card application supports 13 languages for prompting. Languages can be either associated with a user profile or selected from an initial menu.

User Identification

User identification is perhaps the most important feature for Calling Card applications. The MMCS solution offers several security options to guarantee that the Calling Card is being used as agreed upon by a customer. Several criteria must be matched against the saved user configuration data. Calling Card service is disallowed in cases of invalid user identification, no user identification, expired card, insufficient funds left in a Prepaid Debit Card account, expiry of the assigned maximum call duration, the maximum number of calls allowed being reached, and the credit limit being exceeded.

The CLI, when available, can also be used in some configurations.

International Callback

The availability of the International Callback feature provides a significant advantage to the carrier. In many regions of the world, Callback can be used to provide cheaper communications to subscribers. The emerging economies of these countries are providing a market demand for more and inexpensive long distance offerings. The technology, which is implemented on the MMCS as an offshoot of Calling Card technology, will enable carriers to provide this service to their customers, while enjoying the revenues and earnings potential.

The enabling technology of Callback is the international telecommunications network itself. This feature can be set up almost anywhere in the world with limited equipment and implementation costs. At the same time, users reap the benefits from the savings incurred by using this feature.

The MMCS Calling Card feature provides several types of Callback:

- Predetermined Callback, where the called DN is directly mapped to the user profile and the Callback associated number is immediately dialed out.
- Variable Callback, where the caller is requested to enter a Callback destination followed by a room or extension number.
- Predetermined Callback with optional Call Pickup, a combination of both of the above, where the caller may elect to wait off-hook for 15 seconds and wait for the application to answer in order to override the predetermined Callback destination with another one.

Billing Services

Overview

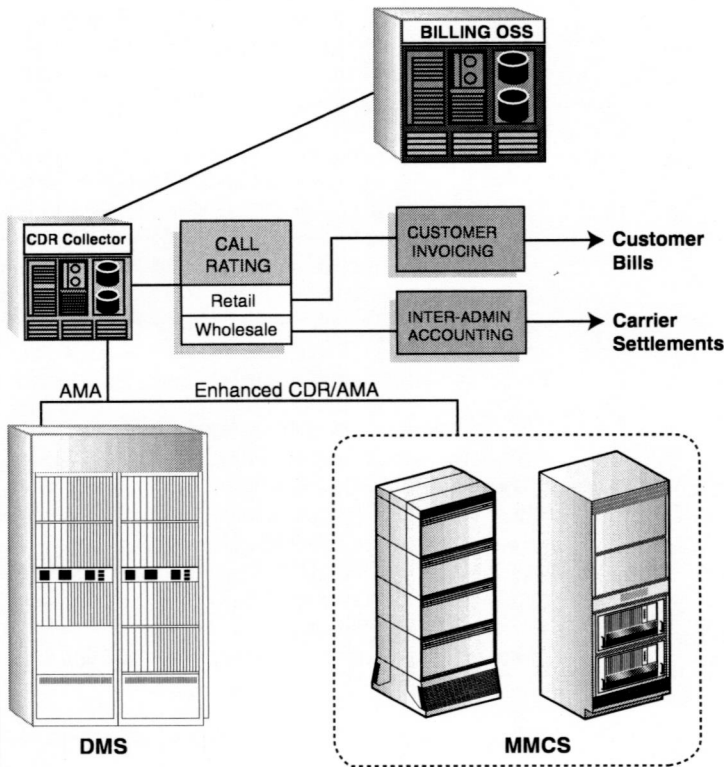
As described earlier, the MMCS product can be positioned in a carrier's network as a simple Point of Presence (POP) switch to provide trunk concentration, or as an enhanced services platform supporting IR, IN, and other value-add services. In both applications, the MMCS will produce comprehensive Call Detail Records for the purpose of downstream customer billing.

In most cases, carriers will be adding MultiMedia Carrier Switches to their existing networks and will expect these Call Detail Records to be processed by existing billing systems which are already set up for the DMS or other vendor switches. In the case of many new licensed operators, the MMCS will represent the first voice switching platform to be implemented. These new licensed operators will therefore require an end-to-end billing solution, including downstream rating and invoicing systems.

Nortel is positioned to offer solutions in both cases. For existing carriers, the MMCS switch will generate Call Detail Records in the Universal BellCore Automatic Message Accounting (AMA) format which is highly flexible and rapidly becoming the industry standard for Call Detail Recording. Most existing billing systems are already capable of processing AMA formatted records; thus, the MMCS will integrate into a carrier's network with little or no effort (that is, it will appear the same as existing switches). For carriers who desire other CDR formats, the MMCS can be customized to output the required format at an additional charge to the customer.

Through partnerships with established Other Equipment Manufacturer (OEM) vendors, Nortel offers complete billing solutions for the MMCS. These solutions are also applicable to Nortel's DMS switching product line, thus providing an integrated billing capability for Nortel's complete switching portfolio. In addition, Nortel offers a number of "back end" billing customization solutions for carriers who require advanced billing capabilities for large business customers. Included are products which support individually customized invoices and customer call analysis tools for users who require network and call statistics in addition to simple invoices.

Figure 25
MMCS Billing Services



Automatic Message Accounting Format

The Call Detail Record (CDR) generated by the MMCS, DMS or any other network element in a carrier’s network contains the basic information required for billing. Depending upon the equipment vendor and/or customer requirements, several different CDR formats are in use by customers today, with the BellCore Universal AMA format being the most popular.

The MMCS supports the BellCore Universal AMA format. Structure Code 04510 has been implemented on MMCS based on the need to support variable length dialing plans in the European marketplace. The MMCS architecture has the flexibility to support other custom formats if required by the customer.

CDR Collection

Most carriers employ external CDR collection systems to pull CDR files remotely from switches or other network elements. This removes the need for costly tape transfers and improves security of billing information by providing an additional level of data validation.

These external “mediation” systems collect CDR files (typically over X.25 network connections – dedicated or dial-up), validate file formats and transmit the files to downstream billing systems for further processing. One collection system can typically handle up to several dozen switches.

Call Rating

Once a CDR file is received by a customer’s billing system, each call record must be rated according to the carrier’s established tariffs. Increasingly, two types of tariffs must be applied on a per-call basis: retail and wholesale. A retail tariff is applied for end-user invoicing; a wholesale tariff is required when a call has involved another carrier (incoming from or outgoing to). The wholesale tariff will determine the amount of revenue due from/to the other carrier. Note that this functionality is not provided by the MMCS, but is part of a carrier’s billing system.

Most existing carrier billing systems are equipped to perform retail rating, but few are capable of wholesale rating without substantial (and costly) upgrades. For this reason, many customers (particularly new licensed operators) will require separate wholesale rating systems and Inter Administration Accounting (IAA) solutions. In addition, many carriers are choosing to implement retail call rating outside of their main billing systems to support real-time call rating, fraud control and other needs not typically provided in existing systems.

Customer Invoicing

The preparation and issuance of final customer invoices are the main functions of a carrier's billing system. The invoicing function requires the assembly of "fixed" customer charges (from customer records), "usage" charges (from retail rating process) and the application of volume or other discounts offered to individual customers. Given the close coupling between the invoicing, customer records and retail rating functions, many carriers have implemented integrated "Subscriber Management" systems which combine all of these functions on a single platform.

Inter Administration Accounting

All calls which require revenue settlement between two carriers will be rated on a retail and wholesale basis. The wholesale rates are usually established by formal Interconnect Agreements between carriers. These agreements also specify the reporting mechanism(s) by which revenue settlements will occur, commonly referred to as IAA requirements. In most instances, carriers will choose to implement IAA reporting in external systems, as the cost of upgrading existing billing systems is prohibitive.

More information on the available billing services can be provided upon request to your local Nortel representative.

Flexible Call Detail Recording Application

The MMCS produces Call Detail Records in order to allow carriers to bill their clients. The Flexible Call Detail Recording application is part of the MMCS that resides on an Application Platform, while the billing processor is the carrier's responsibility and, as such, is not part of the MMCS product.

The Flexible Call Detail Recording application constructs a record with relevant and meaningful fields, giving the carrier enough information to bill the end user with maximum accuracy and resilience.

Call Detail Recording records are produced by the MMCS serving the call (that is, the MMCS on which the call was originated). This MMCS issues a Call Detail Recording ticket for all calls accessing the network (for example, incoming calls from a CPE or PSTN). A ticket is also generated for calls going out over the PSTN or any other toll carrier network.

The MMCS Call Detail Recording ticket is issued by the Flexible Call Detail Recording application, which collects tickets from both the Core Switch and the IR or IN applications. Tickets are stored locally on the Application Platform's hard disk. The carrier's central Billing Server accesses the Application Platform to collect the tickets.

The principle of CDR generation is as follows:

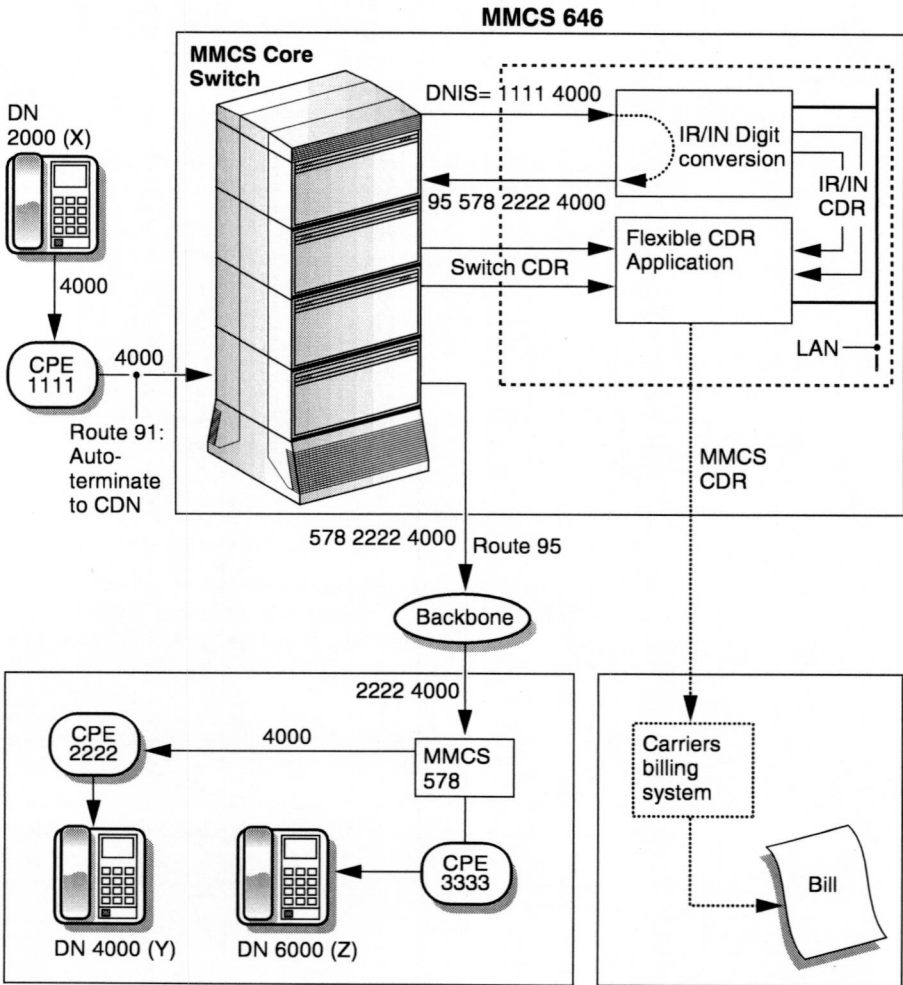
- The Flexible CDR application produces a record for each incoming call served by the IR or IN application (IR/IN CDR).
- At call disconnect time, regardless of whether the call was answered, the Core Switch generates a CDR record (Core Switch CDR). This record includes such items as the destination, duration and bearer capability. If only the Basic Routing option is in use, this will be the only CDR produced by the MMCS.
- The Flexible CDR application collects CDR records to produce an overall MMCS CDR record. If the IR or IN application has produced a ticket, the Flexible CDR application blends the Core Switch CDR with the IR/IN CDR to generate an overall MMCS CDR.
- The MMCS CDR is stored on the hard disk of the Application Platform for a limited time which can be defined by the carrier.
- Hardware redundancy is used to minimize the system's down time and to prevent ticket loss in case of a single point of failure. The system is fully redundant at the CDR interface level to the Core Switch, as well as through the use of two APs (note that only one AP is shown in the following illustration).



FOR MORE INFORMATION

If you require more information about Flexible CDR, please see the *Nortel MMCS CDR Administration Guide*.

Figure 26
MMCS Flexible Call Detail Recording Example



Chapter 4 – Customer Support Services

Nortel is committed to provide comprehensive customer support services that are reliable, low in cost, modular, service-rich, and available in all international markets. Carriers can call upon Nortel resources when and if they need them, thereby leaving themselves time to concentrate on the more important task of managing their core business.

Nortel's end-to-end solution for MMCS support falls into the following areas:

- Pre In-service
 - Project Management
 - Site Survey
 - Installation/Unit Commissioning
 - Customer Engineering
 - Nodal Integration
 - Network Design and Integration
- Post In-service
 - Warranty
 - Post-Warranty
 - Extended Service Plans
 - First Line Maintenance
- Additional Value-added Customer Services
 - Technical Training
 - Customer Documentation

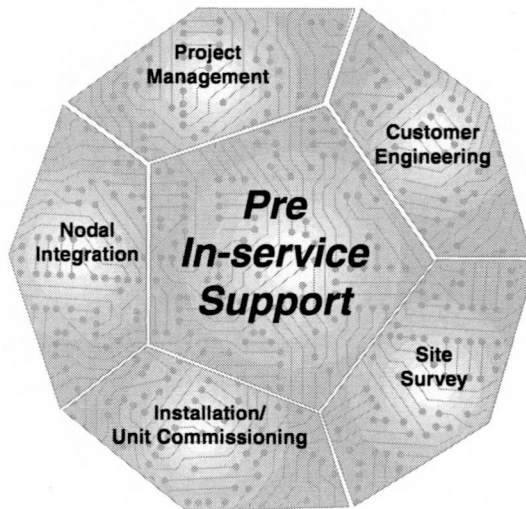


FOR MORE INFORMATION

This section provides a brief introduction to Nortel's MMCS support services. For more comprehensive information, please refer to the *Nortel MMCS Support Services Guide*.

Pre In-service Support

Figure 27
Pre In-service Support Services



Project Management

It is Nortel's policy to create a Project Team, led by a Project Manager, for major network implementations, enhancements, upgrades or trials. The size of the project team is dictated by project requirements, with additional resources available at times of major project activity. The Project Manager can draw on support from installation, technical support, management and field services personnel, in order to give the Project Team sufficient flexibility to meet the stringent implementation requirements.

The Project Manager has overall project responsibility and is the focal point of contact within Nortel for all issues relating to the project.

Site Survey

Nortel will perform a site survey, in accordance with the agreed-upon plan, to ensure that the site being provided for housing the MMCS meets the requirements for proper operation of the equipment. Nortel will provide a report identifying any modifications/enhancements needed to meet the requirements. The customer will be provided with a list of site preparations which must be completed to insure proper installation of the equipment. If the site survey determines that these preparations have not been completed, then Nortel will work with the customer to determine how best to prepare the site.

Nortel will furnish a recommended floor layout for approval by the customer. This approval must be received no later than the date specified within the agreed-upon plan to ensure that information required by manufacturing is available at the appropriate point in the manufacturing schedule.



FOR MORE INFORMATION

For more information about planning your site, please see the *Nortel MMCS Planning Guide*.

Customer Engineering

As part of this service, detailed engineering documents will be developed to include the network numbering plan design, Call Detail Record definition, routing and loss plans, specific digit manipulations, signaling systems and the number of links. From these documents, a detailed configuration will be completed. An experienced Nortel engineer will complete the data definition and datafill.

Installation and Unit Commissioning

Nortel provides total installation services for the MMCS associated hardware and software. Customers will be required to furnish suitable equipment room(s), environmental conditions, and site access prior to the commencement of this activity.

Standard installation and unit commissioning of the MMCS is extremely efficient because of its modular design, the extensive system and subsystem tests performed during the manufacturing process, and extensive use of cable connectorization. This effort is further augmented by field-type tests in the factory and by the development of task-oriented installation documentation.

Customer observation of the installation and test activity is often the most effective method of performing the acceptance of the system, and is, therefore, encouraged. Nortel can, if required, provide the necessary checklists for signature by the customer's on-site representative.

Nodal Integration

Nodal Integration focuses on insuring that the purchased MMCS is connected with the backbone network or PSTN, excluding CPE connections. This process only deals with connecting an MMCS to those components directly linked to it. Nodal Integration activities include:

- the validation of the current software configuration
- the loading of pre-built datafill
- the writing of a Nodal Acceptance Test Plan developed jointly with the customer
- execution of the test cases, and
- mutual acceptance of the test cases.

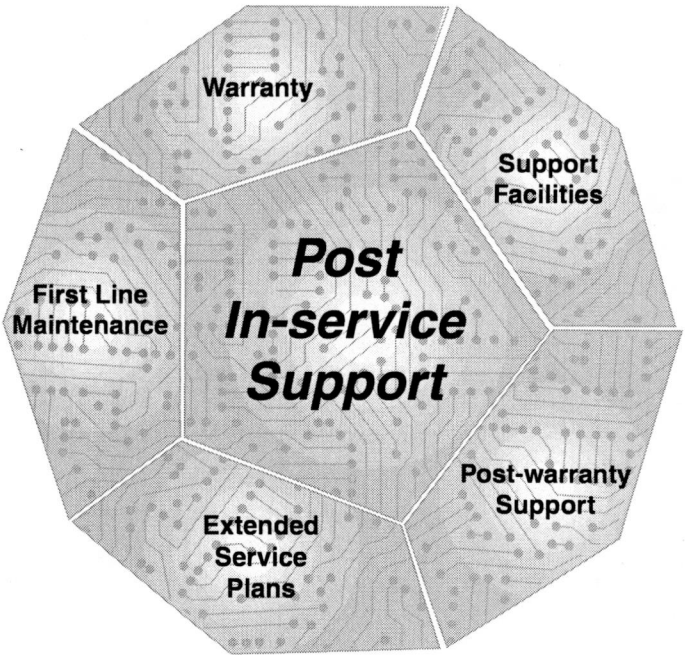
Network Design and Integration

Network Design and Integration involves the integration between components that are not directly connected with the newly purchased MMCS. It may involve the integration of other products within Nortel's product portfolio, as well as other manufacturers' equipment.

Network integration includes compiling an overall network plan and configuration with information gathered from the customer. Nortel will then design an overall network solution which will be finalized and agreed to by all parties. The objective is to deliver a service-ready network customized to meet the individual needs of the carrier.

Post In-service Support

Figure 28
Post In-service Support Services



Warranty

During the first year that an MMCS is in-service the warranty provides:

- a 24-hour Service Desk serving as a single point of contact
- standard and emergency technical service covering both hardware and software, and
- standard and emergency repair and replacement services.

Single Point of Contact

Nortel's support strategy focuses on providing the customer with a "single point of contact" framework. Technical assistance is available to ensure that the customer maximizes the benefit of ownership of the MMCS. Nortel operates a Service Desk on a 365 day per year, and 24 hour per day basis to facilitate access to Nortel Technical Support Services.

The provisioning of the single point of contact has led to a reduction in manpower, as well as process and procedural savings which are passed on to the customer. This enables customer staff to avoid going through numerous processes to report equipment by gender and geographic location. Also, monthly management reports are available which detail such items as call count, network availability and Customer Service Request status.

Customer Service Request Reporting System

Nortel uses a priority driven, automated Customer Service Request (CSR) system to manage and report all customer reported service calls. This valuable service information system allows Nortel to serve customers in a number of ways:

- Expedites Nortel daily service control and responsiveness. The CSR system tracks each request for service to make sure that it is quickly attended to and closed. The system highlights all emergency situations or those that might need extended repair time.
- Delivers telephone system performance data. As the CSR system accumulates data, it can analyze specific system and performance trends. This helps Nortel to provide service responsiveness that is well above normal industry standards.

Customer Technical Services

Customer Technical Services is the second line of support for the MMCS product. Customer Technical Services is staffed by fully-trained technical experts having in-depth knowledge of Nortel's product and services. They are supplied with the latest equipment to ensure early resolution of customer enquiries or difficulties. In addition to providing assistance in resolving standard operations issues on the MMCS, Customer Technical Services are able to assist in emergency situations and in support of cross-product issues.

Product Technical Services

Product Technical Services, or third line support, is centralized at the MMCS Technology Labs in Marne-La-Vallee, France. Captive models for all MMCS products, both new and old, are maintained to simulate complete telecommunications networks.

Product Technical Services is comprised of teams of highly skilled managers and engineers supported by the latest test equipment and technology so that they can respond quickly to customer inquiries, as well as perform in-depth investigations. They have access to design level information and are able to resolve the most complex of problems. Captive models and remote access are used to streamline problem resolution activities.

Engineering and Design Authority

Engineering and Design Authority, or fourth line support, is also located at the Nortel technology labs. This team has developed the MMCS and is responsible for modifications to design specifications or software coding. They provide the highest level of technical support.

Figure 29
Support Models

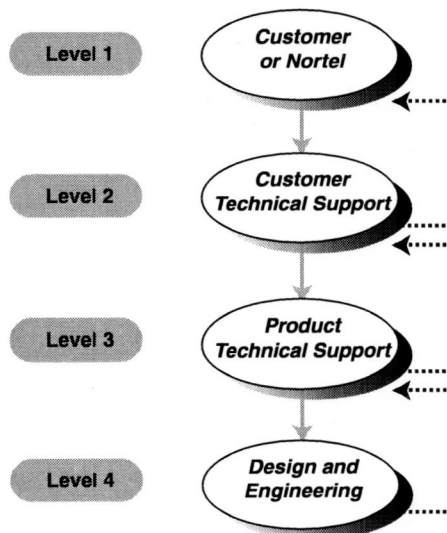


Table 20
Levels of General Support

Level	Responsibilities
1	• Preventative maintenance • Monitor alarms/malfunctions • Corrective action and logging • Local spares holding • Board and module swaps • Product alarm knowledge • Escalate and report
2	• Telephone Service Desk • Log and track problems • Database problem resolution • Isolate subsystem failures • In-house duplication of faults • Site support • Remote modem access • Use of test equipment • Product temporary system solutions • Repair service or manage repairs • Escalate and report
3	• Isolate subsystem and design faults • In-house duplication of faults and testing of short-term fixes • Site support • Remote modem access • Design patches • Escalate and report
4	• Analyze and resolve problems • Log and track problems • Design authority support interface • Design patches, modifications and incorporate in new build • Test and deliver new build to Level 3 support

Replacement/Repair Service

Nortel operates a policy of repair and/or replacement for all defective Nortel supplied MMCS parts returned by Nortel clients for repair. Such parts either were supplied directly by the Nortel MMCS facility or by a recognized Nortel sparing and supply center. Items are tracked on a Nortel shipments database inclusive of OEM products supplied as part of the customer solution.

Nortel provides a standard fifteen month warranty from the date of product shipment or 12 months from the date that the system is accepted by the customer, whichever period expires first. This warranty is applicable to all new items whether purchased as part of an integrated system or as merchandise.

Post-Warranty Support

Nortel's basic warranty service is free of charge during the first year of operation. This one-year warranty can be extended as part of the services contract either at the point of sales or on the anniversary date of the equipment purchase.

Extended Service Plans

Extended Service Plans are available both during the warranty period and afterwards. These extended plans augment the coverage, response times and turnaround times available with the standard service plans.

First Line Maintenance

Nortel can provide a first line maintenance service that is tailored to meet the customer's network requirements. This service can be provided to the customer under the terms and conditions of the support agreement. First line maintenance is not included in the warranty period, but can be contracted for separately. This service includes such items as preventative maintenance, maintenance planning, performance management and spares management.



FOR MORE INFORMATION

For more information about how to maintain your MMCS, please see the *Nortel MMCS Maintenance and Troubleshooting Guide*.

Additional Value-added Customer Services

Technical Training

Nortel will provide carrier personnel with technical training to ensure satisfactory performance in jobs associated with engineering, provisioning, maintaining, and administering of MMCS hardware and software.

Training services are described in full in the "Training Course Catalog," and include instructor-based, computer-based, and paper-based training courses. The instructor-based courses are normally offered at Nortel Training Centers, but may also be available at the customer's location. A Training Course Schedule is issued at regular intervals and includes details about when and where training courses are held.

Customer Documentation

MultiMedia Carrier Switch customer documentation is treated like a product, similar to the system's hardware and software products. As such, the various documents are assigned product codes. Documentation may be ordered as an entire MMCS documentation suite, or can be customized to suit a particular customer's requirements.

Both hard copy and CD-ROM versions of the documentation are available. The CD, in addition to being viewable on the MMS, can be accessed from Macintosh, PC or UNIX systems. CDs come with extensive information search capabilities. In addition, any document on the CD, or portion of a document, can be easily printed should a user desire.

For more information on the available documentation, please consult your local Nortel representative.

Acronyms and Abbreviations

AC15	Channel Associated Signaling system
ACD	Automatic Call Distribution
ADPCM	Adaptive Differential Pulse Code Modulation
AIN	Advanced Intelligent Networking
AMA	Automatic Message Accounting
AML	Application Module Link
ANI	Automatic Number Identification
ANSI	American National Standards Institute
AOC	Advice of Charge
AP	Application Platform
APBase	Application Platform Base
API	Application Programming Interface
APL	Auxiliary Processor Link
ATM	Asynchronous Transfer Mode
AUI	Application User Interface
BARS	Basic Alternate Route Selection
BCAP	Bearer Capability
BCFSM	Basic Call Finite State Machine
BHCA	Busy Hour Call Attempts
BIOS	Basic Input/Output System
BRI	Basic Rate Interface
BRIT	Basic Rate Interface Trunk
BTUP	British Telecom User Part
CAS	Channel Associated Signaling
CAU	MMS Configuration Access Utility
CC	Country Code
CCITT	Consultative Committee on International Telegraphy and Telephony

CCS7	Common Channel Signaling No. 7, also known as SS7
CDBS	Centralized Database Server
CDN	Controlled Directory Number
CDP	Coordinated Dialing Plan
CDR	Call Detail Recording
CLI	Calling Line Identification (generic term)
CLID	Calling Line Identification (term used in ISDN configuration)
CLS	Class of Service
CMDU	Core Multi Drive Unit
CN	Carrier Number
CNI	Calling Number Identification
CO	Central Office
CoS	Carrier Grade of Service
CPE	Customer Premises Equipment
CPU	Central Processing Unit
CS-1R	Capability Set Refinements 1
CTAS	Customer Technical Assistance
CTI	Computer Telephony Integration
CUG	Closed User Group
D70	See INS-Net D70
DASS2	Digital Access Signaling Services 2
DCHI	D-Channel Interface
DDI	Direct Dialing In
DID	Direct Inward Dialing
DIP	Dial Pulse
DISA	Direct Inward System Access
DLFE	DNIS Length Flexibility Enhancement
DMI	Digit Manipulation Index
DMS	Digital Multiplex System
DN	Directory Number
DNIS	Dialed Number Identification Services
DPNA	Direct Private Network Access
DPNSS	Digital Private Network Signaling System
DS0	Digital Signal Level 0 (speed of one voice conversation at 64 kbps as defined by CCITT G.703)
DESC	Distant Steering Code
DSL	Digital Subscriber Loop

DSP	Digital Signal Processing
DTI	Digital Trunk Interface (non-ISDN T-1 trunks in North America and Japan)
DTI2	Digital Trunk Interface (non-ISDN E-1 trunks in countries other than North America and Japan)
DTN	Digitone
DTMF	Dual-Tone Multifrequency
ECC	Error Correction Code
ELM	Event Logging Module
ERWT	Expensive Route Warning Tone
ESIG	ETSI QSIG
ESN	Electronic Switched Network
ETAS	Emergency Technical Assistance
ETSI	European Telecommunications Standards Institute
FCAS	Free Calling Area Screening
FFC	Flexible Feature Code
FGD	Feature Group D
FLEN	Flexible Digit Number
FON	Forced On Net
FNSI	Free Special Number Screening Index
FRL	Facility Restriction Level
FX	Foreign Exchange
GB	Gigabyte
GSM	Global System for Mobiles
GUI	Graphical User Interface
HSL	High Speed Link
IANI	Inband Automatic Number Identification
ICR	Intelligent Call Router
IDC	Incoming Digit Conversion
IE	Information Element
IEC	Inter-Exchange Carriers
IGS	InterGroup Switch
IN	Intelligent Networking
INAP	Intelligent Networking Application Protocol
INS-Net D70	Japanese ISDN Specification for BRI/PRI
I/O	Input/Output
IP	Internet Protocol

IPC	Inter-Process Communications
IPE	Intelligent Peripheral Equipment
IR	Intelligent Routing
IS	In Service
ISDN	Integrated Services Digital Network
ISM	Incremental Software Management
ISRM	Initial Service Request Message
ISUP	Integrated Services Digital Network User Part
ITR6	German ISDN protocol
ITU	International Telecommunications Union (formerly CCITT)
JDMI	Japanese Digital Multiplex Interface
LAN	Local Area Network
LAP-B	Link Access Procedure Balanced
LDN	Listed Directory Number
LOC	Location Code
MB	Maintenance Busy
MB	Megabyte
MCDN	Meridian Customer Defined Network
MFC	Multifrequency Compelled Signaling
MFE	Multifrequency Enhanced
MFK	Multifrequency protocol for Spain
MIF	MMCS Intelligent Networking Foundation
MIM	Maintenance Information Messages
MISP	Multipurpose ISDN Signaling Processor
MMCS	MultiMedia Carrier Switch
MMS	MultiMedia Carrier Switch Management System
MOOS	Manual Out of Service
MSDL	Multi-Purpose Serial Data Link
MTBF	Mean Time Between Failures
MTP	Message Transfer Part
MTTR	Mean Time To Repair
NARS	Network Alternate Route Selection
NAUT	Network Authorization Code
NCOS	Network Class of Service
NMS	Network Management System
NPA	Numbering Plan Area

NPI	Numbering Plan Identification
NSC	Network Speed Call
NSN	National Subscriber Number
NXX	Local Exchange Code
OA&M	Operations, Administration, and Maintenance
OLI	Originating Line Identity
OOS	Operations Support Systems
OS	Operating System
OSI	Open Systems Interconnection
OSLC	Originating Site Location Code
PBX	Private Branch Exchange
PDD	Protected Digital Data Block
PLN	Private Local Network
POP	Point of Presence
PPM	Periodic Pulse Metering
PRI	Primary Rate Interface (23B+D – T1 trunks; 1.544 Mbps)
PRI2	Primary Rate Interface (30B+D – E1 trunks; 2.0 Mbps)
PSTN	Public Switched Telephone Network
PTT	Post Telegraph and Telephone administration
PWS	Provisioning Workstation
Q.767	Subset of Q.761-Q.764 recommendations for CCS7 ISUP signaling
Q.931	ISDN users network interface Layer 3 specification for basic call control
QSIG	ECMA protocol standard for multi-vendor inter-PBX ISDN signaling
R2MFC	MFC variant (protocol used in public telephone networks that uses a combination of frequencies for registered signaling)
RAM	Random Access Memory
RAN	Recorded Announcement
SBE	Standard Bus Extender
SC	System Clock
SCCP	Signaling Connection Control Part
SCE	Service Creation Environment
SCP	Service Control Point
SCU	MMS Server Control Utility
SDE	Service Development Environment

SDI	Serial Data Interface
SDDR	Supplemental Digit Restriction and Recognition
SICA	Signaling Category
SP	Signaling Point
SPN	Special Number
SQL	Structured Query Language
SR	Simple Resale
SS7	Signaling System 7 (Bellcore term for CCS7)
SSP	Service Switching Point
SSRM	Subsequent Service Request Message
STBY	Standby
STP	Signaling Transfer Point
SVGA	Super Video Graphic Adapter
TCAP	Transaction Capability Application Part
TCP/IP	Transmission Control Protocol/Internet Protocol
TGAR	Trunk Group Access Restriction
TKID	Trunk Identification
TLI	Terminating Line Identity
TN	Terminal Number
TOD	Time of Day
TON	Type of Number
TSC	Trunk Steering Code
TTA	Time to Answer
TTY	Teletype
TUP	Telephone User Part
UDP/IP	User Datagram Protocol/Internet Protocol
UEM	Universal Equipment Module
UPS	Uninterrupted Power Supply
UUS	User-to-User
VN	Vacant Number
VNR	Vacant Number Routing
VNS	Virtual Network Services
VPN	Virtual Private Network
WAN	Wide Area Network
WATS	Wide Area Telephone Service
X.25	ITU-T standard protocol providing devices with direct connection to a packet-switched network



Nortel MultiMedia Carrier Switch Product Guide

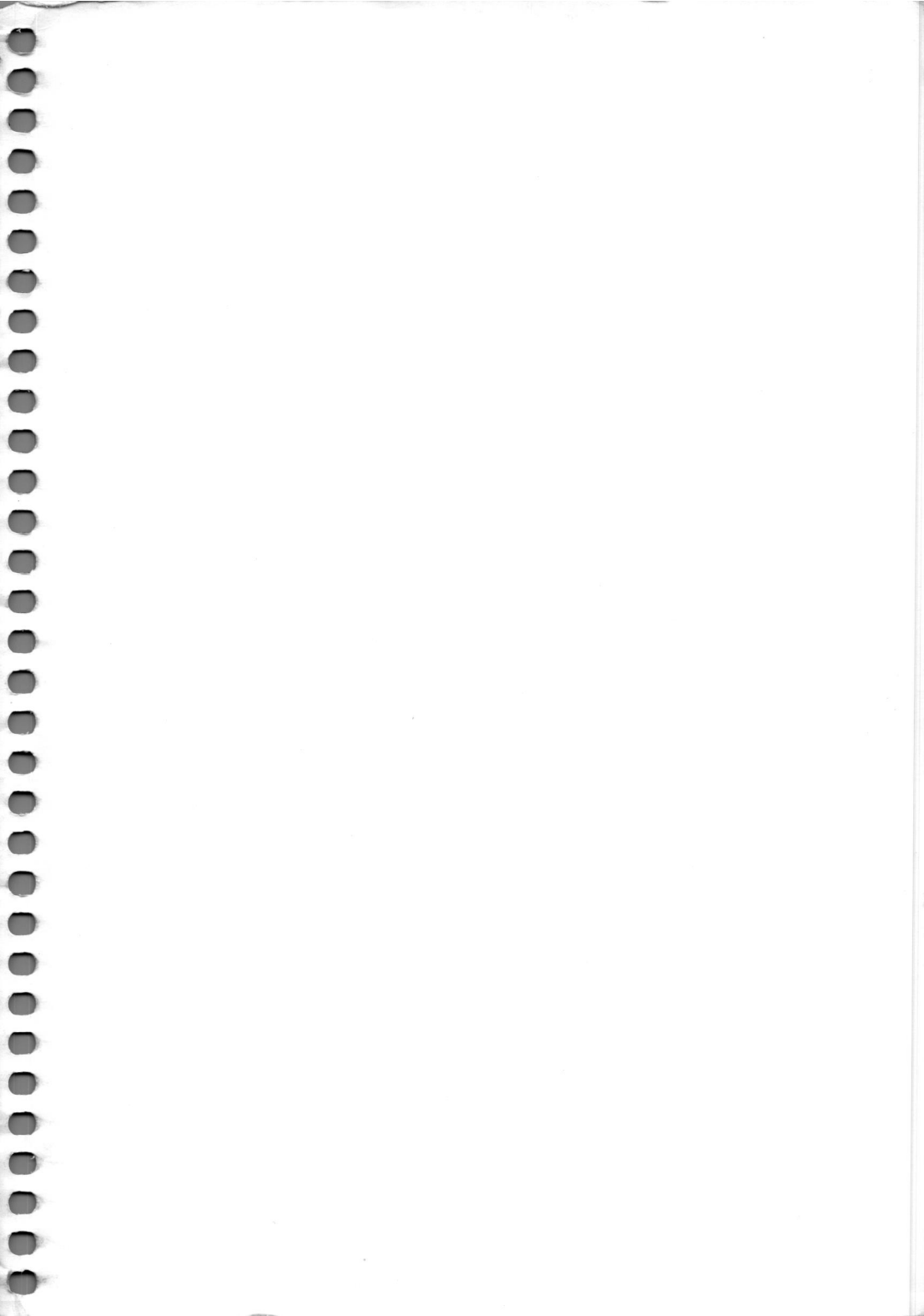
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